

THE
NEW GRESHAM
ENCYCLOPEDIA
VOLUME V

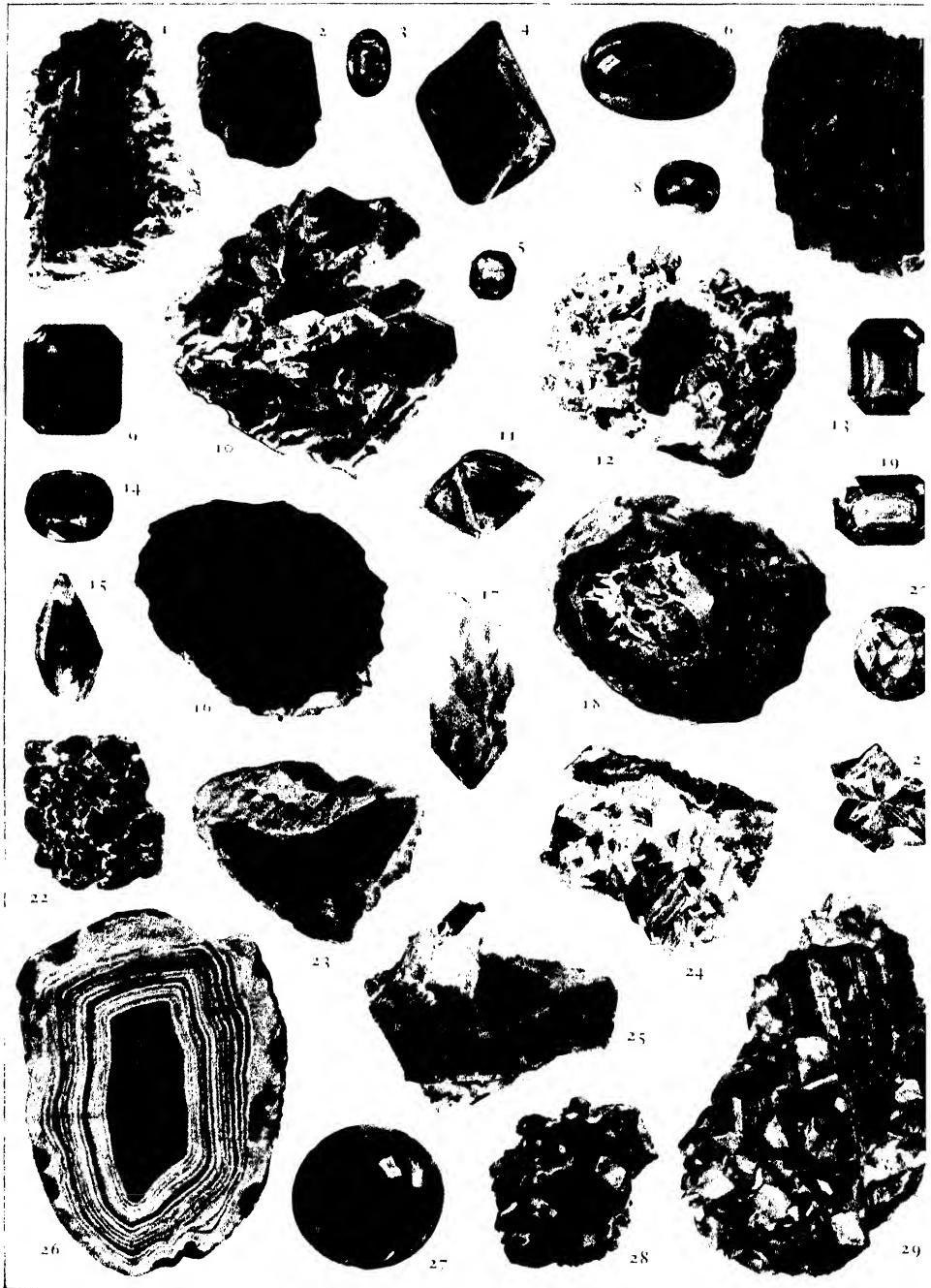
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GEMS



1, Tourmaline. 2, 3, Ruby. 4, 5, Red Spinel. 6, Caruncle. 7, 8, Garnet. 9, Topaz. 10, Amethyst. 11, Yellow Diamond. 12, Emerald. 13, Peridot. 14, 15, Sapphire. 16, Bloodstone. 17, Citrine. 18, Opal. 19, Cairngorm. 20, 21, Chrysoberyl. 22, Turquoise. 23, Sard. 24, Sphene (in Felspar). 25, Blue Topaz. 26, Agate. 27, Cat's Eye. 28, Jargon or Jacynth. 29, Beryl (in White Topaz).

THE NEW·GRESHAM ENCYCLOPEDIA

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KEY TO PRONUNCIATION

The method of marking pronunciations here employed is either (1) by marking the syllable on which the accent falls, or (2) by a simple system of transliteration, to which the following is the Key:—

VOWELS

ā, as in <i>fate</i> , or in <i>bare</i> .	<i>eu</i> , a long sound as in Fr. <i>jeûne</i> =Ger. long <i>ö</i> , as in <i>Söhne</i> , <i>Göthe</i> (Goethe).
ä, as in <i>alms</i> , Fr. <i>âme</i> , Ger. <i>Bahn</i> =á of Indian names.	<i>eu</i> , corresponding sound short or medium, as in Fr. <i>peu</i> =Ger. <i>ö</i> short.
â, the same sound short or medium, as in Fr. <i>bal</i> , Ger. <i>Mañn</i> .	ō, as in <i>note</i> , <i>moan</i> .
a, as in <i>fat</i> .	o, as in <i>not</i> , soft—that is, short or medium.
u, as in <i>fall</i> .	ö, as in <i>move</i> , <i>two</i> .
a, obscure, as in <i>rural</i> , similar to <i>u</i> in <i>but</i> , é in <i>her</i> : common in Indian names.	û, as in <i>tube</i> .
ē, as in <i>me=i</i> in <i>machine</i> .	u, as in <i>tub</i> : similar to é and also to <i>a</i> .
e, as in <i>met</i> .	u, as <i>i</i> . <i>bull</i> .
é, as in <i>her</i> .	ü, as in Sc. <i>abune</i> =Fr. <i>û</i> as in <i>dû</i> , Ger. <i>ü</i> long as in <i>grün</i> , <i>Bühne</i> .
ī, as in <i>pine</i> , or as <i>ei</i> in Ger. <i>mein</i> .	û, the corresponding short or medium sound, as in Fr. <i>but</i> , Ger. <i>Müller</i> .
i, as in <i>pín</i> , also used for the short sound corresponding to ē, as in French and Italian words.	oi, as in <i>oil</i> .
	ou, as in <i>pound</i> ; or as <i>au</i> in Ger. <i>Haus</i> .

CONSONANTS

Of the *consonants*, **b, d, f, h, j, k, l, m, n, ng, p, sh, t, v, z**, always have their common English sounds, when used to transliterate foreign words. The letter **c** is not used by itself in re-writing for pronunciation, **s** or **k** being used instead. The only consonantal symbols, therefore, that require explanation are the following:—

ch is always as in <i>rich</i> .	s, always as in <i>so</i> .
d, nearly as <i>th</i> in <i>this</i> =Sp. <i>d</i> in <i>Madrid</i> , &c.	th, as <i>th</i> in <i>thin</i> .
g is always hard, as in <i>go</i> .	th, as <i>th</i> in <i>this</i> .
h represents the guttural in Scotch <i>loch</i> , Ger. <i>nach</i> , also other similar gutturals.	w always consonantal, as in <i>we</i> .
ñ, Fr. nasal <i>n</i> as in <i>bon</i> .	x=ks, which are used instead.
r represents both English <i>r</i> , and <i>r</i> in foreign words, which is generally much more strongly trilled.	y always consonantal, as in <i>yea</i> (Fr. <i>ligne</i> would be re-written <i>lěny</i>).
	zh, as <i>s</i> in <i>pleasure</i> =Fr. <i>j</i> .

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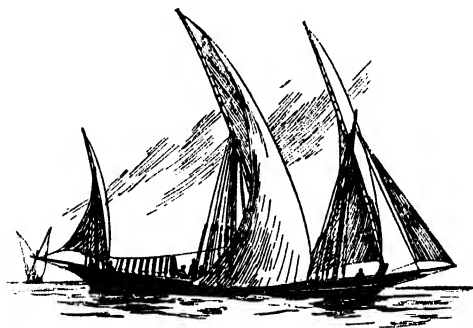
Felt, a kind of cloth made of wool, or of wool and cotton united by rolling, beating, and pressure. The materials to be felted are carded and placed in a machine, where they are kept wet and intimately mixed together by a process of beating. Pressure then unites the whole into a compact mass. The use of felt as a material for hats, tents, or cloaks is very ancient. For hat-making the fur of rabbits, beavers, raccoons, and the wool of sheep is generally used. Felt, being a good non-conductor of heat, is much used for roofing, sheathing boilers, hot-water reservoirs, &c. The felt for such purposes is made from the coarsest woollen refuse from paper-mills.—Cf. Murphy, *The Textile Industries*.

Feltre (fel'trā), a town in Northern Italy, about 44 miles N.N.W. of Venice, with cathedral, and episcopal seminary. Captured by Austrian troops during the European War, the town was recaptured in Oct., 1918. Pop. 15,390.

Feluc'ca, a long narrow vessel, generally undecked, of light draught, and rigged with large

vince of Schleswig-Holstein, separated from the mainland by a shallow strait about 1 mile broad. The island has a fertile but marshy soil. The inhabitants are chiefly agriculturists and fishers. Pop. 9800.

Femgerichte, Fehmgerichte, or Vehmgerichte (fām'ge-rih-te; from O.Ger. *fem*, punishment, and *gericht*, a court), criminal courts of Germany in the Middle Ages, which took the place of the regular administration of justice (then fallen into decay), especially in criminal cases. These courts originated and had their chief jurisdiction in Westphalia, and their proceedings were conducted with the most profound secrecy. They seem to have been a survival of old territorial jurisdictions which, on the general distraction and lawlessness prevalent after the fall of Henry the Lion (1182), acquired an extensive and tremendous authority. In process of time, however, they degenerated, and no longer confined themselves to law and precedent, so that the secrecy in which they enveloped themselves only served as a cloak to their criminal purposes. The flagrant abuse of their power brought about their fall. In 1461 various princes and cities of Germany, as well as the Swiss confederates, united in a league against them, but their influence was not entirely destroyed until an amended form of trial and penal judicature was introduced. The last Femgericht was held at Zell in 1568. The president of the secret tribunal was called the *Freigraf*, and was generally a prince or count. His associates, who concurred in and executed the sentence, were called *Freischöffen*. These were scattered through all the provinces of Germany, and recognized one another by certain signs and watchwords. They acknowledged the emperor as their superior, and for this reason generally made him one of their number at his coronation at Aix-la-Chapelle. The assemblies of the tribunal were open or secret. The former were held by day, in the open air; the latter by night, in a forest or in



Felucca

lateen sails. They also carry from eight to twelve large oars. They are common in the Mediterranean.

Femern (fā'mérn), an island of Prussia, pro-

concealed and subterranean places. In these different cases the circumstances of judgment and the process of trial were different. The crimes of which the secret tribunal usurped cognizance were heresy, sorcery, rape, theft, robbery, and murder. The accusation was made by one of the Freischöffen, who, without further proof, declared upon oath that the accused had committed the crime. The accused was now thrice summoned to appear before the secret tribunal, and the citation was secretly affixed to the door of his dwelling or some neighbouring place; the accuser remained unknown. If, after the third summons, the accused did not appear, he was once more cited in a solemn session of the court, and if still contumacious, was given over to the Freischöffen. The first Freischöffe who met him was bound to execute the decree of the court. A dagger was left by the corpse to show that it was not a murder, but a punishment inflicted by one of the Freischöffen. How many judicial murders were perpetrated in this manner from revenge, interested motives, or malice, may well be imagined.

Fe'mur, in vertebrate animals, the first bone of the leg, situated next the trunk of the body, and in man popularly called the thigh-bone. The term is also applied to the third joint (counting from the base) of an insect's leg.

Fen, a marsh or stretch of wet boggy land often containing extensive pools. The *Fens*, or the *Fen District*, is a special term for a marshy district of England, extending into the counties of Cambridge, Lincoln, Huntingdon, Northampton, Norfolk, and Suffolk. A great part of the district is known as the Bedford Level. Much of the land has been reclaimed at vast expense. The soil of fen lands is generally black and rich to a depth of 2 or 3 feet, and with proper management in the matter of draining they will produce heavy crops of grass and corn.

Fences, continuous lines of obstacles artificially interposed between one portion of the surface of the land and another for the purpose of separation or exclusion. Live fences are made of hawthorn, holly, box, beech, &c.; dead fences of stone, wood, and in recent times of iron or wire. In agriculture fences are necessary both for restricting the tenant's own animals to their pasture, and for protecting his land from straying animals. The general erection of fences on farms is one of the improvements of modern agriculture.

Fen'cibles, a sort of local militia raised for defence in case of invasion, and not liable to be sent to serve out of the country. The term *volunteers* was afterwards applied to those who undertook this kind of service.

Fencing, the art of attack and defence with sword or rapier, no shield being used. It was

in Italy in the sixteenth century that the skillful use of the small sword first became common. The art spread to Spain and then to France, where, on account of the prevalence of duelling, it was brought to a high degree of development. The small sword or rapier (which was adopted for duelling) has a point, but no edge, and therefore demands the highest degree of adroitness in its use. In the fencing schools the instrument adopted for exercise is called a foil; it has a guard of metal or leather between the handle and blade, which is made of pliant steel and has a button at the end in place of a point. The parries are made with the weapon itself by opposing the *forte* of the foil (i.e. the strong part from the handle to the centre) to the *feible* of the adversary's foil (i.e. the part from centre to point); the upper part of the body to the right is defended by the parry called *tierce*, the upper part to the left by the *carte*, and the lower part by the *seconde*. In all parrying care must be taken that in covering the side attacked the other side is not too carelessly exposed to the enemy. After every parry a return should be made with rapidity and decision. The fencer should rely more upon his sword hand for protection than upon his agility of leg; yet he must be active on his legs so as to advance, retreat, or lunge with effect. The knees should therefore be somewhat bent when the fencer is on guard, that he may be light and elastic in his movements. An attack may be made by the mere extension of the arm, or accompanied by a lunge, that is, by advancing the body, stepping forward with the right foot without moving the left. An *engagement* means the crossing of the blades; a *disengagement*, slipping your foil under the opponent's and then pressing in the opposite direction; *riposte*, the attack without pause by a fencer who has parried. Fencing with the broadsword differs essentially from that with the foil, as the former has an edge as well as a point, and is therefore meant to cut as well as thrust. According to the instructions of drill-masters there are seven cuts, with corresponding guards, and three thrusts. Cut *one* is a diagonal, downward cut at the left cheek of the adversary; cut *three* is delivered with an upward slope at the left leg, and cut *five* horizontally at the right side; cuts *two*, *four*, and *six* attack the right cheek, right side, and right leg respectively; and cut *seven* is directed vertically at the head. Guards *one* and *two* defend the upper portion of the body, the sword sloping upwards in an opposite direction to the opponent's; guards *three* and *four* protect the legs, the sword sloping downwards; guards *five* and *six* defend the sides, when the sword is held vertically, point downwards; and guard *seven* protects the head, the blade meeting the enemy's almost at a right

angle.—BIBLIOGRAPHY: Egerton Castle, *Schools and Masters of Fence*; Hutton, *The Sword and the Centuries*; C. A. Thimm, *A Bibliography of Fencing and Duelling*.

Fénelon (fān-lōn), François de Salignac de la Mothe, one of the most venerable of the French clergy, born in 1651 at the Château Fénelon, in Périgord, of a family illustrious in Church and State, died in 1715. A gentle disposition, united with great vivacity of mind and a feeble and delicate constitution, characterized his youth. He was educated under the eye of his uncle, the Marquis de Fénelon, and afterwards at St. Sulpice, Paris. He took orders at the age of twenty-four, and distinguished himself in the work of converting Protestants. In 1681 his uncle conferred on him the priory of Carennac. Soon after he wrote his first work, *Traité de l'Éducation des Filles*, which was the basis of his future reputation. In 1689 Louis XIV entrusted to him the education of his grandsons, the Dukes of Burgundy, Anjou, and Berri. During his preceptorship he became acquainted with Mme Guyon (q.v.). In 1694 he was created Archbishop of Cambrai. A theological dispute (see *Quietism*) with Bossuet, the virtual head of the French Church, terminated in his condemnation by Pope Innocent XII, and his banishment to his diocese by Louis XIV. Fénelon submitted without the least hesitation, and thenceforward lived contentedly in his diocese, sustaining the venerable character of a Christian philosopher, and scrupulously performing his sacred duties. He left numerous works in philosophy, theology, and belles-lettres. The most celebrated is *Les Aventures de Télémaque*, in which he endeavoured to exhibit a model for the education of a prince. It was commonly taken for a satire on the reign of Louis XIV, though nothing, probably, was further from the mind of Fénelon.—BIBLIOGRAPHY: E. K. Sanders, *Fénelon: his Friends and his Enemies*; M. Masson, *Fénelon et Mme Guyon*; P. Janet, *Fénelon: his Life and Works*.

Fen'ians, a name usually derived from Fionn or Finn, the name given to a semi-mythical class of Irish warriors famous for their prowess. The name has been assumed by those Irish conspirators who formed a brotherhood in their own country and in America, with the intention of delivering Ireland from the sovereignty of England, and establishing an Irish republic. About the end of 1861 the Fenian Brotherhood was regularly organized in America; and its chief council, consisting of a 'head-centre', John O'Mahoney, and five other members, which had its seat at New York, soon had branches in every state of the Union; while at the same time large numbers joined the cause in Ireland, where James Stephens was 'head-centre'. The close of the American Civil War, when large numbers

of trained Irish soldiers who had taken part in the war were released from service, was thought to be a convenient time for taking some decisive steps. Two risings were planned in Ireland, but they were both frustrated by the energetic measures of the British Government, the first, in Sept., 1865, by the seizure of the office of the *Irish People*, the Fenian journal published at Dublin, in which papers were found which revealed to the Government the secrets of the conspiracy, and which led to the capture of the ringleaders, Luby, O'Leary, O'Donovan Rossa, and others; the second, in Feb., 1866, was as speedily suppressed by the suspension of the Habeas Corpus Act in Ireland. An invasion of Canada, attempted in the same year, failed as miserably as the attempt in Ireland, and convinced the Irish that they could not expect the aid from the United States on which they had hitherto counted. At last, on 5th March, 1867, the long-prepared insurrection broke out almost simultaneously in the districts of Dublin, Drogheda, and Kerry. The number of insurgents in the field, however, did not exceed 3000, and though they burned some police stations, they nowhere faced the troops sent after them. About the same time some forty or fifty Irish-Americans landed in a steamer near Waterford, but soon after fell into the hands of the police. In 1870 and 1871 two raids were again made on Canada, but both were ridiculous failures, the first being repulsed by the Canadian Volunteers, and the second suppressed by the United States Government.—BIBLIOGRAPHY: J. Rutherford, *Secret History of the Fenian Conspiracy*; Justin McCarthy, *A History of Our Own Times*; J. O'Leary, *Recollections of Fenians and Fenianism*.
Fenland. See *Fen*.

Fenn, George Manville, novelist, born in 1831, died in 1900. He became a teacher, but afterwards turned to literature, and contributed short sketches to *All the Year Round*, *Chambers's Journal*, *Once a Week* (of which he became proprietor), and to the *Star* newspaper. In 1867 he published *Hollowdell Grange*, a story for boys, which was followed by a long series of tales and novels, many of them boys' stories. They include: *Bent, not Broken* (1867); *The Parson o' Dumford*; *Eli's Children*; *The New Mistress*; *Double Cunning*; *The Master of the Ceremonies*; *The Man with a Shadow*; *A Double Knot*; *The Mynns Mystery*; *King of the Castle*; *In an Alpine Valley*; *Bluejackets*; *High Play*. Several of his tales were specially written for Christmas. His boys' books include: *In the King's Name*, *Nat the Naturalist*, *Bunyip Land*, *Menhardoc*, *Patience Wins*, *Brownsmith's Boy*, *Commodore Junk*, *The Crystal Hunters*, *The Grand Chaco*, and *Fire Island*.

Fennec (*Canis zerda*), a small animal allied

to the dog and fox, and sometimes called the Sahara fox, being a native of that region. It lives on birds, jerboas, lizards, dates, &c., burrows with great facility, and is easily tamed.



Fennec or Sahara Fox (*Canis zerda*)

It is fox-like in appearance, and is remarkable for the great size of its ears.

Fennel, a fragrant plant, *Feniculum officinale*, cultivated in gardens, belonging to the nat. ord. Umbelliferae. It bears umbels of small yellow flowers, and has finely divided leaves. The fruits, or in common language the seeds, are carminative, and frequently employed in medicine.—*Giant fennel* is a popular name for *Ferula communis*, which attains sometimes a height of 15 feet.

Fenton, a town of England, in the north of Staffordshire, immediately south-east of Stoke-upon-Trent, in which parliamentary borough it is included. The industries include china and earthenware, brick-making, coal-mining, and iron-founding. Pop. (urban district), 25,026.

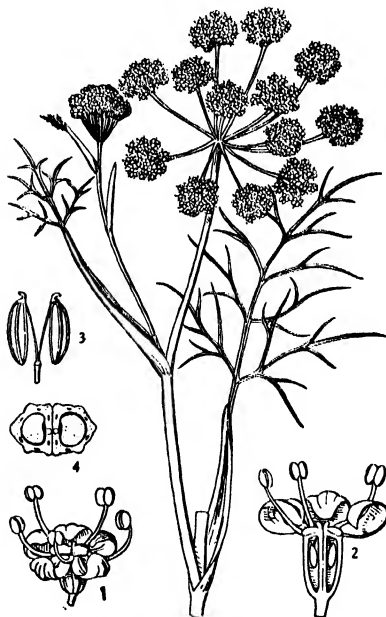
Fen'ugreek, a leguminous plant, *Trigonella Fænum græcum*, whose bitter and mucilaginous seeds are used in veterinary practice. It is an erect annual, about 2 feet high, a native of the south of Europe and of some parts of Asia.

Fe'odor, the name of three Russian princes.—**Feodor I**, son of Ivan the Terrible, reigned from 1584 to 1598. He was a feeble prince, who allowed himself to be entirely governed by his brother-in-law, Boris Godunov. With him the Russian dynasty of Rurik became extinct.—**Feodor II**, son of Boris Godunov, reigned only for a short time in 1605.—**Feodor III**, the son of Tsar Alexis, reigned from 1676 to 1682, warred with the Poles and Turks, and, by the Peace of Baktchisarai, obtained possession of Kiev and some other towns of the Ukraine.

Feodo'sia (formerly *Kaffa*), or **Theodosia**, a town in the south-east of the Crimea. From 1266 to 1474 this town was in possession of the Genoese, in whose hands it became the seat of an extensive commerce with the East, and is said to have had a population of 80,000. It is still one of the most important towns in the Crimea. Pop. 43,114.

Feoffment (fēf'ment), in law, that mode of conveying property in land where the land passes by livery in deed, that is, actual delivery of a portion of the land, as a twig or a turf; or when the parties, being on the land, the feoffer expressly gives it to the feoffee. As the statute of uses has introduced a more convenient mode of conveyance, feoffments are now rarely used except by corporations. Further, they are now of no effect unless accompanied by deed. See *Seizin*; *Sasine*.

Feræ naturæ ('of a wild nature'), the name given in the Roman law to beasts and birds that live in a wild state, as distinguished from those which are *domitæ naturæ*, that is, tame animals, such as horses and sheep. The right of property in such animals exists only as long as they are



Fennel (*Feniculum officinale*)

1, Flower. 2, Longitudinal section of flower. 3, Fruit. 4, Section of fruit.

in a state of confinement or within the boundaries of the possessor's lands, unless it can be proved that any special animal had been trained to return to its master's property.

Fer-de-lance (fer-de-läns), the lance-headed viper or *Craspedocephalus* (*Bothrops*) *lanceolatus*, a serpent common in Brazil and some of the West Indian Islands, and one of the most terrible members of the rattlesnake family (*Crotalidæ*). It is 5 to 7 feet in length. The tail ends in a horny spine which scrapes harshly against rough objects but does not rattle. Its bite is almost certainly fatal.

Ferdinand, ex-Tsar of Bulgaria, born in Vienna 26th Feb., 1861, the son of the Prince of Saxe-Coburg-Gotha and the Princess of Orléans. He was chosen Prince of Bulgaria in July, 1887, but when Austria seized Bosnia and Herzegovina, in 1908, Ferdinand declared the complete independence of Bulgaria and assumed the title of Tsar of the Bulgars. Closely allied with Austria and Germany, he at first observed a strict neutrality at the beginning of the European War, but in October, 1915, joined the Central Powers. After the final defeat of Germany, and at the outbreak of revolution in his own country, he abdicated the throne on 4th Oct., 1918. He was married twice, his first wife being Princess Marie-Louise of Bourbon-Parma, by whom he had four children, and his second, Princess Eleonora of Reuss, who died in 1916.

Ferdinand, German emperors:—1. **Ferdinand I**, brother of Charles V, and born at Alcalá, in Spain, 10th March, 1503. In 1522 he received the Austrian lands of the House of Habsburg from the emperor, to which were afterwards added the kingdoms of Hungary and Bohemia in right of his wife, Anna of Hungary. On the abdication of Charles he succeeded to the imperial title. He died 25th July, 1564.—2. **Ferdinand II** was born in 1578, and succeeded his uncle Matthias as Emperor of Germany in 1619. He was of a dark and reserved character, and had been brought up by his mother and the Jesuits bitterly to hate Protestantism. The result was a quarrel with his Bohemian subjects, who openly revolted and offered the Bohemian crown to the Elector Palatine, a step which led in 1619 to the outbreak of the Thirty Years' War. With the help of the Catholic League and John George, Elector of Saxony, he was placed firmly on the throne of Bohemia, where he relentlessly persecuted the Protestants. He died 15th Feb., 1637.—3. **Ferdinand III**, son of the preceding, was born in 1608, and succeeded his father in 1637. He had served in the Thirty Years' War and had seen the miseries which it occasioned, and was reluctant to continue it. There were eleven years more of it, however, before the Peace of Westphalia was concluded in 1648. Ferdinand died in 1657.

Ferdinand V, King of Aragon, who received from the Pope the title of *the Catholic*, on account of the expulsion of the Moors from Spain, was

the son of King John II, and was born 10th March, 1453. On the 18th of Oct., 1469, he married Isabella of Castile, and thus brought about that close connection between Aragon and Castile which became the basis of a united Spanish monarchy and raised Spain to pre-eminence amongst European states. After a bloody war of ten years, they conquered Granada from the Moors (1491); but the most brilliant event of their reign was the discovery of America, which made them sovereigns of a new world. (See *Columbus*.) This politic prince laid the foundation of the Spanish ascendancy in Europe by the acquisition of Naples (1503), and by the conquest of Navarre (1512); but his policy was deceitful and despotic. He instituted the Court of the Inquisition at Seville in 1480, and, to the great injury of Spanish commerce, expelled the Jews (1492) and Moors (1501). He died in 1516.—Cf. W. H. Prescott, *Ferdinand and Isabella*.

Ferdinand I, of Bourbon, King of the Two Sicilies (previously Ferdinand IV of Naples), born 12th Jan., 1751, died in Jan., 1825. He was the third son of Charles III, King of Spain, whom he succeeded, in 1759, on the throne of Naples, on the accession of the latter to that of Spain. In 1768 he married Maria Caroline Louisa, daughter of the Empress Maria Theresa, who soon acquired a decided influence over him. After the death of Louis XVI, Ferdinand joined the coalition against France, and took part in the general war from 1793 to 1796; but in 1799, after the defeat of the Neapolitans under General Mack, the French took possession of the whole kingdom, and proclaimed the Parthenopean Republic. The new republic did not last long. Ferdinand returned to Naples in 1800. Six years later he was again driven from Naples by the French, and compelled to take refuge in Sicily, where he maintained himself by the aid of the British. The Congress of Vienna finally re-established Ferdinand IV in all his rights as King of the Two Sicilies in 1814, while Naples was still occupied by Murat. But after the flight of the latter in March, 1815, Ferdinand once more entered Naples, 17th June, 1815. In 1816 he assumed the title of Ferdinand I, King of the Two Sicilies. In 1820, in consequence of a revolution, Ferdinand was obliged to swear to support a new and more liberal constitution. The Austrians, however, came to his help, and re-established him in possession of absolute power. He was succeeded by his son, Francis I.—Cf. R. H. Johnston, *The Napoleonic Empire in Southern Italy*.

Ferdinand II, King of the Two Sicilies, born in 1810, died 22nd May, 1859. He succeeded his father, Francis I, on the 8th of Nov., 1830. The revolution of France in this year had un-

settled the minds of men throughout the Continent generally, and Ferdinand was at first forced to make some concessions to his subjects, but soon recalled them, determining thenceforward to make his will the only law. The result was a series of popular outbreaks, culminating in the year 1848, when Ferdinand earned the nickname of King Bomba by bombarding his capital from the forts. Despotism was again established by force of arms, and when Bomba died his prisons were crowded with the best and bravest of his subjects. He was succeeded by his son, Francis II, who lost his crown when Italy was united in 1860 under Victor Emmanuel.—Cf. H. R. Whitehouse, *The Collapse of the Kingdom of Naples*.

Ferdinand VII, King of Spain, eldest son of Charles IV, and of Maria Louisa of Parma, born in 1784; ascended the throne in March, 1808, when a popular rising forced his father to abdicate in his favour. A month later he himself abdicated in favour of Napoleon, who conferred the crown on his brother Joseph. Ferdinand returned to Spain in March, 1814. His arbitrary conduct caused an insurrection in 1820, which was at first successful, but Louis XVIII of France having sent an army to his aid, his authority was once more made absolute in Spain. Having no sons, he abolished the Act of 1713 by which Philip V had excluded women from the throne of Spain, and then left his crown to his daughter Isabella to the exclusion of his brother, Don Carlos. It was during the reign of this king that the Spanish colonies in America broke away from the mother country.

Ferdinandea. See *Graham Island*.

Fère (fâr) en Tardenois, a town of N.E. France, department of Aisne, at the confluence of the Serre and the Oise, a fortress of the second rank. Taken by the Germans during the European War, the town was recaptured by the French in July, 1918. Pop. 2530.

Ferenti'no, a town in Central Italy, 6 miles north-west of Frosinone. It has remains of ancient walls, built of hewn stone without mortar. Pop. 12,390.

Fer'etory, a kind of box made of gold or other metal, or of wood variously adorned, and usually in the shape of a ridged chest, with a roof-like top, for containing the relics of saints. It is borne in processions.

Ferghana', a province of Turkestan, formed in 1876 out of the conquered khanate of Khokand. It consists mainly of a valley surrounded by high ranges of mountains and traversed by the Sir-Darya and its tributaries; area, 55,483 sq. miles. The climate is warm, and the soil in part fertile, but a considerable portion of the country is desert. Pop. about 2,169,600. Khokand is the capital.

Fer'guson, Adam, Scottish historical and political writer, born in 1724, died in 1816. In 1757 he succeeded David Hume as Keeper of the Advocates' Library, Edinburgh, in 1759 was made professor of natural philosophy in the university, and in 1764 of moral philosophy. He resigned his chair in 1784. Among his chief works are an *Essay on Civil Society* (1767), *Institutes of Moral Philosophy* (1769), *History of the Roman Republic* (1783), *Moral and Political Science* (1792).

Ferguson, James, an eminent experimental philosopher, mechanist, and astronomer, was born of poor parents at Keith, in Banffshire, in 1710, died in 1776. While a boy tending sheep he acquired a knowledge of the stars, and constructed a celestial globe. With the help of friends he went to Edinburgh, where he studied mathematics and drawing, making such rapid progress in the latter that he was able to support himself by painting miniatures. In 1743 he went to London, where he painted and gave lectures in experimental philosophy. Amongst his hearers was George III, then Prince of Wales, who afterwards settled on him a pension of £50 a year. His principal works are: *Astronomy Explained upon Sir Isaac Newton's Principles* (1756); *Lectures on Mechanics, Hydrostatics, &c.* (1760); *Select Mechanical Exercises* (1773).

Fergusson, James, a writer on architecture, born at Ayr in 1808, died in 1886. He went out to India as partner of an important commercial house, but after some years retired from business to devote himself to the study of architecture and early civilizations. In 1845 he published *Illustrations of the Rock-cut Temples of India*; in 1849, *A Historical Enquiry into the True Principles of Beauty in Art*; in 1851, *The Palaces of Nineveh and Persepolis Restored*; in 1855, *Illustrated Handbook of Architecture*; in 1862, *History of the Modern Styles of Architecture*, a sequel to the handbook, both being afterwards combined in *History of Architecture in All Countries* (3 vols., 1865–7), and completed by a *History of Indian and Eastern Architecture* (1876). He also wrote *Notes on the Site of the Holy Sepulchre at Jerusalem, Tree and Serpent Worship*, and *Rude Stone Monuments in All Countries*.

Fergusson, Robert, Scottish poet, was born at Edinburgh 17th Oct., 1750, died 16th Oct., 1774. He was educated at St. Andrews University, and became clerk to a writer of the signet in Edinburgh. He wrote poems, of which those in the Scottish dialect have genuine poetic excellence. His convivial habits undermined his health, and he died at the early age of twenty-four, after being confined in a lunatic asylum for two months. He was buried in the Canongate Churchyard, Edinburgh, where Burns erected a monument to the memory of this kindred genius,

to whom he owed suggestions for several of his own poems.

Ferish'ta, more properly Mohammed Qasim, a Persian historian, born at Astrabad about 1550, died about 1612. He went to India with his father, and was for some time the tutor of a native prince. He wrote a *History of the Mohammedan Power in India*, which is the best yet written on the period which it embraces.

Fermanagh (fer-mä'nà), an inland county in Ireland, in the province of Ulster; area, 715 sq. miles, or 457,369 acres. The county is divided lengthwise into two nearly equal portions by Lough Erne, and exhibits a succession of abrupt eminences of slight elevation, but is mountainous towards its western boundary. The soil is variable, and not remarkably fertile. The manufactures are unimportant. Politically it is divided into North Fermanagh and South Fermanagh, each sending one member to Parliament. Pop. 61,836. County town, Enniskillen.

Fermentation is a general term applied to changes in organic compounds by the action of bodies called ferments. These are: (a) micro-organisms, or distinctly organized ferments; (b) enzymes, or unorganized ferments.

Micro-organisms may secrete enzymes, and the products formed by the action of the micro-organism depend upon the kind of organism predominating. The fermentation is called alcoholic, acetic, lactic, butyric, &c., according to the substance which predominates in the liquor after fermentation.

Enzymes include such bodies as diastase, invertase, pepsin, ptyalin, emulsin, glucase, &c. Their action is hydrolytic.

The organized vegetable ferments are: (1) mould growth (Hyphomycetes), (2) yeast plants (Saccharomycetes), (3) bacteria (Schizomycetes).

The moulds (Hyphomycetes) are thread-like plants, devoid of chlorophyll, and form a somewhat felted mass called the mycelium. They grow upon damp organic matter where ventilation is faulty, and are injurious in fermenting processes, developing musty or sour odours and taste in the nutrient medium. Thus *Penicillium Glaucum*, a green mould, *Aspergillus Glaucus*, also green, and *Aspergillus Niger*, a dark mould, oxidize sugar to organic acids.

The bacteria, splitting ferments, or Schizomycetes, are rods, spirals, threadlike or rounded cells, and propagate by fission, i.e. splitting into parts, with great rapidity. They cause oxidation and decomposition, and often putrefaction, producing extremely poisonous end products. Many of the 'diseases' of wine and beer, as well as acetic, lactic, butyric, and other fermentations, are caused by them. Pasteurization, or heating to 70° C., is not a sure protection against their action, but steam at 100° C., or superheated

steam, kills them instantaneously. The following varieties of bacteria are of great use industrially:

Acetic Acid Bacteria.—These cause the oxidation of alcohol thus: $\text{CH}_3\text{-CH}_2\text{OH} + \text{O}_2 = \text{CH}_3\text{COOH} + \text{H}_2\text{O}$. There are various kinds of this class of bacterium, they grow in dilute alcoholic fluids, and mineral and nitrogenous matter is necessary for their nutrition. They are used in vinegar manufacture (q.v.).

Lactic Acid Bacteria.—These split sugar into lactic acid thus: $\text{C}_6\text{H}_{12}\text{O}_6 = 2\text{C}_3\text{H}_7(\text{OH})\text{COOH}$, and cause the souring of milk. They occur in fruit, corn, grain, &c., and are used in lactic acid manufacture (q.v.).

Butyric Acid Bacteria ferment sugar and other carbohydrates and lactic acid into butyric acid thus: $2\text{C}_4\text{H}_{10}\text{O}_2 = \text{C}_4\text{H}_7\text{COOH} + 2\text{CO}_2 + 2\text{H}_2$. Many kinds exist, and cause the souring of cut beet, the ripening of cheese, the retting of flax, &c. They may do great damage in the brewery, however.

Proteolytic Bacteria are used in the tannery in the 'bating' or 'puering' process. The bacteria produce enzymes having a solvent action on the fibres of the skin, making it supple.

Nitrogen-fixing Bacteria are of great importance to agriculturists. The nitrosomonas and the nitrosococcus convert ammonia into nitrites. The nitric organism converts nitrites to nitrates.

Other Bacteria are used technically in the dairy, in the preparation of indigo, tobacco, tea, &c., and especially in the modern method of sewage disposal, where noxious substances are converted into harmless carbon dioxide and water by special bacteria cultivated on the filter beds. Sulphur bacteria absorb sulphuretted hydrogen and other sulphur compounds, producing sulphates and even sulphuric acid; some will give fusel-oil and acetone, some glycerine, &c.

The yeasts (Saccharomycetes) are single-cell Fungi, and are of great technical importance. *Saccharomyces cerevisiae* is the ferment in beer; *S. ellipsoideus* is the ferment in wine, and causes spontaneous fermentation of fruit juices.

Biology of Yeast.—The Saccharomycetes belong to a sub-group in the Fungi division of the Thallophyta. The Fungi class is divided into two divisions: (a) Phycomycetes or Algæ group; (b) Mycomycetes. The latter group is divided into two divisions: (a) true Ascomycetes, which include moulds like Eurotium and Penicillium; (b) Hemiasci, which includes yeast.

The Saccharomycetes propagate either by budding—e.g. during vigorous fermentation of a saccharine solution—or by fission and endogenous spore formation, which is characteristic of the Schizomycetes; or by endospore formation, which is affected by temperature, amount of air present, amount of moisture present, age of cells, and the food-supply available.

Yeast consists of an aggregation of plant cells, forming a slimy yellow mass of peculiar odour and with an acid reaction. The most favourable temperature for propagation is 6° to 25° C., and the substances necessary for a growing plant must be present, i.e. a fermentable sugar, nitrogenous matter, phosphates and sulphates of calcium, potassium, and magnesium.

Yeasts are also grouped into two classes: (a) top yeasts; (b) bottom yeasts. The former require a temperature of 15° to 30° C., the fermentation being very active, and the carbon dioxide which is rapidly evolved carries the yeast to the surface. It is used for heavy ale and beer, for alcohol and high wines. Bottom yeast acts between 4° to 10° C.; the fermentation is slow, the evolution of carbon dioxide is gradual, and the yeast remains at the bottom of the vat.

Saccharomyces can be also divided into eight classes:—

Saccharomyces cerevisiae, a top and bottom ferment depending upon circumstances.

S. Pasteurianus I, a bottom beer ferment which gives an unpleasant taste, but has no apparent action on beer.

S. Pasteurianus II, a top ferment in beer.

S. Pasteurianus III, a top ferment in beer, producing cloudiness and disease in beer.

S. ellipsoideus I, a bottom yeast, the true wine ferment.

S. ellipsoideus II, a bottom yeast causing cloudiness in turbid beer.

Carlsberg No. 1 yields a beer with less carbon dioxide than No. 2, and is used for bottled beers.

Carlsberg No. 2 is used for export beers

It is consequently best to use a pure culture, and this is obtained by propagating from a single plant in the presence of sterilized nutrient material.

Structure and Life Conditions of Yeast.—The minute egg-shaped single cells in beer are about 0.01 mm. in diameter. The cell consists of protoplasm enclosed by a cellulose wall, and containing a spherical nucleus which becomes visible on staining. At the end of the fermentation, vacuoles appear filled with a low refractory liquid and granules, which are highly refractory bodies. The yeast propagates by budding, and under special conditions forms endospores, the cell dividing into two or four spores, which then germinate into new yeast cells. The spores of culture yeast appear empty; those of wild yeast are strongly refractive.

When heated in water at 75° C., yeast is killed, but when dry, can live from -130° C. to +100° C. Alcoholic fermentation occurs between 0° to 50° C., the optimum temperature being 28° to 34° C. Yeasts retain vitality longest in a 10 per cent solution of sucrose. Most yeast races com-

pletely ferment a 25 per cent sugar solution, but a 60 per cent solution is unattacked. Yeasts require amides, peptones, phosphates, sulphates, and salts of potassium and magnesium for their growth. Oxygen is also necessary.

Most yeast cells cease to propagate in a solution containing over 5 per cent by volume of alcohol, although powerful yeasts can generate a solution containing 25 per cent alcohol.

Yeasts may be divided into culture and wild yeasts, and culture yeasts include: (a) *Saccharomyces cerevisiae*, both top and bottom yeasts; and (b) *Saccharomyces ellipsoideus*, the wine ferment.

Brewery yeast must generate the characteristic aromatic taste and odour, and must separate from the fluid. A distillery yeast must have a high fermenting power to produce the maximum amount of alcohol. A bakery yeast should be rapid in action, and generate much alcohol and carbon dioxide to raise the dough.

English brewers use high or top fermentation yeast, working between 28° to 34° C. Porter, stout, ale, Weissbiere, Braunbiere, &c., are made thus. For lager beers low or bottom fermentation yeasts are used, working at 4° to 10° C.

Wine yeasts belong to *Saccharomyces ellipsoideus*; each different wine district produces distinct and characteristic *ellipsoideus* races, and hence experts can distinguish wines from different districts by the various tastes and bouquets.

Other Yeasts.—*Saccharomyces pyriformis* produces alcoholic fermentations of ginger beer.

Schizosaccharomyces pombe ferments dextrose in negro millet beer, and is used in South America.

Schizosaccharomyces mellacei occurs in Jamaican rum.

Wild yeasts are not cultivated, because they produce unpleasant effects.

See *Brewing*, *Distillation*, and articles on alcoholic liquors, e.g. *Wines*, *Whisky*, *Vinegar* (lactic acid and butyric acid); *Yeast*.

The Enzymes or Unorganized Ferments.—The enzymes are complex nitrogenous substances of high molecular weight, similar in elementary composition to albumen, and soluble in cold water, from which they are easily precipitated by alcohol. Their activity falls with rise in temperature, whilst at 80° C. most enzymes are destroyed. Their aqueous solutions rapidly putrify. Antiseptics and strong mineral poisons, such as formaldehyde, phenol, strong mineral acids or bases, lead, copper, mercury, and zinc salts, destroy enzymes.

These substances attack complex molecules, splitting or 'hydrolyzing' them into simpler substances, usually with the addition of water. Hence starch, fats, and albumen become soluble. The action of the enzyme is often reversible. It is by the aid of enzymes that food-stuffs are rendered soluble and are digested.

Since each enzyme is characterized by its capacity of performing one specific action, they are classified according to the action they perform.

1. *Diastatic enzymes* convert insoluble carbohydrates like starch and cellulose into soluble sugars. Diastase occurs in malt, ptyalin in saliva, cellulase dissolves cellulose, inulase dissolves inulin.

2. *Inverting enzymes* transform disaccharides into simpler sugars, usually hexoses. Sucrase hydrolyzes cane-sugar; maltase converts maltose into two molecules of glucose; lactase converts milk-sugar into *d*-glucose and *d*-galactose; melibiase occurs in bottom fermentation yeasts, and converts melibiose into *d*-glucose and *d*-galactose.

3. *Enzymes decomposing glucosides*. Emulsin decomposes amygdalin into grape sugar, benzaldehyde, and hydrocyanic acid.

4. *Proteolytic enzymes* decompose various proteids into simpler bodies, even into the simple amino-acids. Pepsin decomposes albuminous bodies into peptones, trypsin decomposes albuminous substances into leucin, tyrosin, and other amino-acids, and papain acts on flesh.

5. *Clotting enzymes* coagulate milk, precipitating the casein and leaving the milk-sugar in solution. Thrombase coagulates blood, and pectase produces vegetable jellies.

6. *The lipases* split fats into glycerine and fatty acids.

7. *The oxidases* oxidize various substances, e.g. laccase, tyrosinase.

8. *Enzymes decomposing amides*, e.g. urase in urine, decomposing urea into carbon dioxide and ammonia.

9. *Enzymes producing alcohol*.

Fermo, a town of Middle Italy, province of Ascoli Piceno, on a height about 4 miles from the Adriatic, on which is its port, Porto di Fermo. Pop. (commune), 22,570.

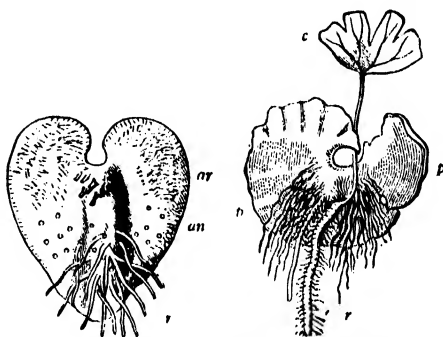
Fermoy', a town in Ireland, County Cork, on the Blackwater, here crossed by a fine bridge. It contains Fermoy College and St. Colman's Roman Catholic College, and has barracks accommodating 3000 men. It has large flour-mills and a considerable trade in corn. Pop. 11,826.

Fernan'do Noronha (no-ron'yá), a small island in the Atlantic, forming one of a small group of the same name about 210 miles north-east of the coast of Brazil, to which it belongs, and by which it is used as a penal settlement. It is defended by forts. The group is essentially volcanic in character; the vegetation of the tropical American type, remarkable for the immense number of creepers which festoon the trees. The population is about 2000, 1400 of whom are criminals.

Fernan'do Po, a Spanish island in the Bight of Biafra, off the west coast of Africa, about 20

miles from the mainland. It is of volcanic origin, and is of an oblong form, broadest at the south extremity, 35 miles long and 22 miles broad. It is traversed from north to south by a ridge of mountains terminating in a magnificent cone, 11,040 feet high, called Clarence Peak. The island is picturesquely covered with forests and luxuriant vegetation, chiefly palms and the bombax or silk-cotton tree. There are several harbours in the island. The population is about 25,000 (1910), partly a mixture of negroes, Portuguese, and other Europeans, partly native-born negroes. The capital is Clarence Town.

Ferns (Filices or Filicales), a nat. ord. of cryptogamous or flowerless plants, forming the largest group of the Pteridophyta. The familiar



Prothallium of Fern

ar, Archegonia. an, Antheridia. r, Rhizoids.

Young Fern - plant developing from the Embryo

p, Prothallium. r, Primary root. c, Cotyledon or first leaf.

fern-plant is the *sporophyte*; its leaves—often called fronds—arise from a rhizome or root-stock, or from an arborescent trunk, and are circinate in veneration, a term descriptive of the manner in which the fronds are rolled up before they are developed in spring, when they have the appearance of a bishop's crosier. On the veins of their lower surface, or their margins, the fronds bear small vessels named *sporangia*, containing spores. These spore-cases are arranged in clusters, named *sori*, which are either naked or covered with a layer of the epidermis, which forms an involucre or *indusium*. When the spores germinate, they produce a delicate cellular *gametophyte*, called the *prothallus*, which in due course bears sexual organs, the *antheridia* and *archegonia*. The antheridia give rise to a number of spirally coiled *spermatozoids*, which swim about by means of numerous flagella. The archegonia resemble those of Bryophytes, but are more or less sunk in the prothallus and have but a short neck. Spermatozoids are attracted to the archegonia by the malic acid which these

secrete when ripe. The oöspore produced by fertilization quickly develops into a new sporophyte, which soon establishes itself as an independent plant. Ferns have a wide geographical range, but are most abundant in humid, temperate, and tropical regions. In the tropical forests the tree-ferns rival the palms, rising sometimes to a height of 50 or 60 feet. Ferns are very abundant as fossil plants. The earliest-known forms occur in Devonian rocks. Various systems of classification for ferns have been proposed. At present the order is usually divided into about a dozen families distinguished by

largest division is that of the Polypodiaceæ, to which nearly all British ferns belong, such as the polypody, the lady-fern, the bracken, the hard-fern, the spleenwort, the maiden-hair, the hart's-tongue fern, &c. The royal fern, however, belongs to the Osmundaceæ. A few of the ferns are used medicinally, mostly as demulcents and astringents. Some yield food. *Pteris esculenta* is the edible bracken of New Zealand.

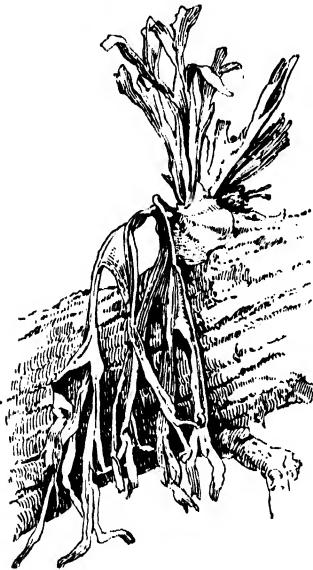
Ferozepoor. See *Firozpur*.

Ferra'ra, a city of N. Italy, capital of the province of same name, 26 miles N.N.E. of Bologna, in a fertile but unhealthy plain. It is a well-built town with many remains of the splendour and commercial prosperity it enjoyed under the House of Este. Under the Papal rule it fell into decay, and has now a deserted appearance. The old ducal castle or palace (now occupied by public offices), several other palaces, the cathedral, the public picture-gallery, the houses where Ariosto and Guarini lived, the cell in which Tasso was imprisoned, a monument to Savonarola, who was born there, the university (founded in 1264, and reopened in 1815), the public library, the old walls, &c., deserve mention. Pop. about 35,000.—The province was formerly a duchy of Italy held by the House of Este as a Papal fief from 1471 till 1597, when it fell to the Pope. At the unification of Italy under Victor Emmanuel in 1860 it gave its name to a province bounded on the north by the Po, east by the Adriatic, south and west by Ravenna, Bologna, and Modena; area, 1019 sq. miles; pop. 326,447 (1915).

Ferra'ri, Giuseppe, an Italian philosopher, born 1812 at Milan, died at Rome in 1876. He studied law at Pavia, but afterwards devoted himself to literature. He first won notice by his edition of Vico's works (1836-7). Having gone to France, he was professor of philosophy at Strasbourg for a number of years. In 1859 he returned to Italy, becoming successively professor at Turin and Milan. Amongst his principal writings are: *Essai sur le Principe et les Limites de la Philosophie de l'Histoire* (1847), *Filosofia della Rivoluzione* (1851), *Corso di Lezioni sugli Scrittori Politici Italiani* (1862).

Ferreira (fer-a'i-rà), Antonio, Portuguese poet, born at Lisbon 1528, died in 1569. He carried to perfection the elegiac and epistolary style, and added to Portuguese poetry the epithalamium, the epigram, ode, and tragedy. His tragedy of *Ines de Castro* is still considered by the Portuguese as one of the finest monuments of their literature.

Ferrer, Francisco, Spanish revolutionist, born in 1859, died in 1909. He founded lay schools for the purpose of advancing rationalist and socialist teaching, and in 1909 he participated in the insurrections at Barcelona. His activities



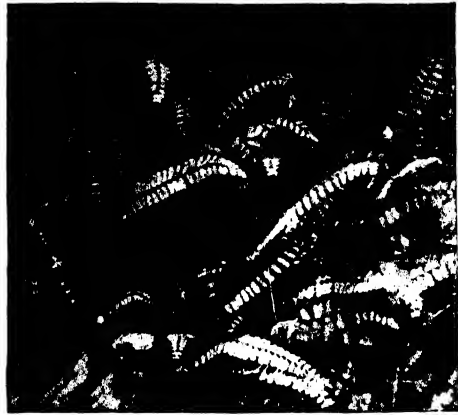
Platycerium alcornocum, an Epiphytic Fern

differences in the structure and arrangement of the sporangia. It is customary to separate the more primitive families with large massive sporangia, such as the Botryopteridæ (extinct) and Marattiaceæ, as *Eusporangiate* ferns from the more advanced *Leptosporangiate* types with small delicate sporangia. The Leptosporangiate families conform to one of three types, as regards the arrangement and succession of the sporangia in the sorus. In the Simplices (e.g. Gleicheniaceæ) all the sporangia of a sorus are produced simultaneously; in the Gradatæ (e.g. Hymenophyllaceæ) they arise in basipetal order, i.e. there is a definite succession in both space and time; in the Mixtæ (including the Polypodiaceæ and some more primitive genera) they arise successively, but in no definite order. The generic characters are founded on the position and direction of the sori and on the venation. The

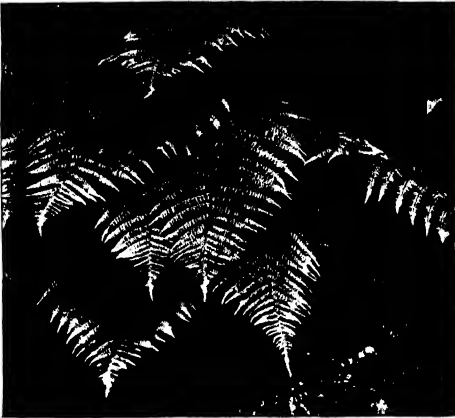
FERNS



Hart's-tongue (left), and Royal Fern



Maidenhair Spleenwort



Shield Fern



Common Polypody



Hard Fern



Lady Fern, Male Fern behind

were directed against Roman Catholic influence in Spanish politics. He was condemned for his revolutionary agitation, and shot on 13th Oct., 1909. The execution of Ferrer excited much indignation, not only in Spain, but also in France.

Fer'ret, a domesticated albino variety of the polecat (*Putorius fætidus*), about 14 inches in length, of a pale-yellow colour, with red eyes. It is a native of Africa, but has been introduced into Europe. It cannot, however, bear cold, and cannot subsist even in France except in a



Ferret (*Putorius fætidus*)

domestic state. Ferrets are used in catching rabbits, to drive them out of their holes.

Fer'rier, Sir David, a distinguished authority on the physiology of the brain, was born near Aberdeen in 1843. He studied at Aberdeen University, graduating with distinction in 1863, and in the same year he carried off the Ferguson inter-university scholarship in classics and philosophy. After studying for a short time at Heidelberg, he took the medical course at Edinburgh, and graduated M.D. in 1870, with very high distinction. In 1872 he became professor of forensic medicine in King's College, London, a chair which he exchanged in 1889 for that of neuro-pathology, specially founded for him, a position which he long held. He became F.R.S. in 1876, in 1880 received a royal medal, and was knighted in 1911. His researches on the brain have necessitated a large number of experiments on living animals, and he has, in consequence, been attacked by the anti-vivisectionists. His results are stated in his works on *The Functions of the Brain* (1876), and *Cerebral Localization* (1878-90). He was also the founder and editor of *Brain: a Journal of Neurology*.

Ferrier, James Frederick, a Scottish metaphysician, born at Edinburgh in 1808, died at St. Andrews 11th June, 1864. After studying at Edinburgh and Oxford, he was admitted to

the Scottish Bar in 1832, but gave his attention more to literature than to law. His contributions to *Blackwood's Magazine*, then at the height of its fame, brought him into notice, and in 1845 he was appointed to the chair of moral philosophy at St. Andrews. His chief work is *The Institutes of Metaphysics*, in which he attempts to build up in a rigorously logical and deductive method a complete system of knowing and being.

Ferrier, Susan Edmonstone, novelist, the aunt of the preceding, was born in Edinburgh in 1782, died at Edinburgh in 1854. Her life was chiefly spent in her native town. In 1818 she made her first appearance as an authoress by the publication of the novel *Marriage*, which acquired great popularity. *The Inheritance* appeared in 1824; and *Destiny, or the Chief's Daughter*, in 1831. The novels of Miss Ferrier are full of a genial humour, and no one has succeeded better in depicting the manners of the upper middle class in Scotland at a time when the national peculiarities were still in a great measure intact.

Ferro, or **Hierro**, the most south-western and smallest of the Canary Islands, about 18 miles long and 9 miles broad. This island, having once been supposed the most western point of the Old World, was formerly employed by all geographers to fix their first meridian, and the longitude reckoned from it. As first meridian its conventional place is 20° w. of Paris and 17° 40' w. of Greenwich. Pop. 7667.

Ferrol' (Lat. *Ardobrica*), a fortified seaport of Northern Spain, in the province and about 12 miles N.E. of the town of Coruña, on a fine inland bay, connected with the sea by a channel so narrow as to admit only one ship-of-the-line at a time. The chief naval arsenal of Spain, established by Ferdinand VI in 1752 on a magnificent scale, is here. The manufactures consist chiefly of swords, cutlery, and military and naval equipments. Pop. 26,270.

Ferry, a particular part of a river, lake, arm of the sea, &c., where a boat or other conveyance plies to carry passengers or goods from the one side to the other. The right of establishing a public ferry is usually the prerogative of a Government or Legislature. The person who has a right of ferry is required to keep a boat or boats suitable for the conveyance of passengers, to charge a reasonable fare, and to provide the requisite landing-places on either bank of the river. No one is allowed to establish a rival ferry so near the original one as to destroy its custom. Common rowing-boats, sailing-boats, large flat-bottomed barges pulled along a rope stretched from bank to bank for horses and carriages, and steam and motor ferry-boats are among the conveyances. During the European War a train ferry across the English Channel

was constructed in 1918. The services were organized from Richborough and Southampton to Calais, Dunkirk, Dieppe, and Cherbourg, and the ferries used only for military purposes.

Ferry, Jules François Camille, French statesman and writer, born at St. Dié in the Vosges, 5th April, 1832, died in 1893. He became a barrister at Paris, but devoted himself almost entirely to journalism. His articles in the *Presse*, *Courrier de Paris*, and *Temps*, from 1856 to 1869, brought him much into notice, and in 1869 he was returned as Deputy for the sixth arrondissement of Paris and took his seat among the members of the 'Left'. After the fall of Sedan he became a member of the Government of the National Defence. In 1872 Thiers appointed him Minister-Resident at Athens. In 1879 he became Minister of Public Instruction, and as such introduced an Education Bill, which amongst other things forbade unauthorized communities, such as Jesuits, to teach in schools. In 1880 Ferry, having become Premier, entered upon a vigorous foreign policy. His seizure of Tunis in 1881 was so far successful, though it led to his resignation; but when again Premier, in 1883, his expedition to Tonquin landed France in troubles through which (1885) he was driven from office. In 1893 he was elected President of the Senate, but soon after he was shot by a madman and died.—Cf. A. Rambaud, *Jules Ferry*.

Ferté-sous-Jouarre (fer-tā-sō-zhō-är), La, a town of France, department of Seine-et-Marne, 37 miles E.N.E. of Paris. Pop. 5000.

Fer'ula, a genus of umbelliferous plants, whose species often yield a powerful stimulating gum resin, employed in medicine. The species are natives of the shores of the Mediterranean and Persia, and are characterized by tall-growing pithy stems, and deeply divided leaves, the segments of which are frequently linear. *F. communis* of English gardens is called giant fennel. *F. orientalis* and *F. tingitana* are said to yield African ammoniacum, a gum resin like asafetida, but less powerful.

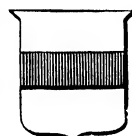
Fescen'ine Verses, rude Latin verses in the form of a dialogue between two persons, who satirized and ridiculed each other's failings and vices with great freedom of speech. They originated in country districts in ancient Italy, but were ultimately introduced into the towns, and formed part of the ceremony at marriages and on other occasions of festivity. The name is probably derived from *fascinum*, fascination, although the origin of the verses has been ascribed to the Etruscan town of Fescennia.

Fesch (fesh), Joseph, half-brother of Napoleon's mother, was born at Ajaccio in 1763, died in 1839. He had devoted himself to an ecclesiastical life, but quitted it on the outbreak

of the French revolution, and became commissary of war to the army of the Alps. After the restoration of Catholic worship he resumed his ecclesiastical status, and became in 1802 Archbishop of Lyons, and next year a cardinal. After the fall of Napoleon he retired to Rome, where he died.

Fes'cue, the popular name of a genus of grasses (*Festuca*) belonging to the division with many-flowered spikelets on long stalks. Amongst the numerous species are some of the most valuable meadow and pasture grasses of Britain. *F. pratensis*, or meadow fescue, and *F. duriuscula* or hard fescue, are both highly prized for agricultural purposes. *F. ovina*, or sheep's fescue, is much smaller than either of these, and is useful for lawns. It is abundant in mountain pastures. *F. clatior*, the tall fescue, is a coarse reedy grass with stem usually 4 or 5 feet high. All these species are perennial.

Fesse (fes), in heraldry, a band or girdle comprising the centre third part of the shield, and formed by two horizontal lines drawn across it; it is one of the nine honourable ordinaries. The fesse-point is the exact centre of the escutcheon.



Fesse

Festiniog, a town of North Wales in Merioneth, with important slate-quarries; also a great tourist centre. Pop. 8143.

Fes'tivals, or **Feasts**, certain days or longer periods consecrated to particular celebrations either in honour of some god or in commemoration of some important event. Such festivals have prevailed among nearly all nations, both ancient and modern. Amongst the Jews there are six festivals prescribed in the Scriptures (*Lev. xxiii*), and thence called sacred feasts. These are the weekly feast of the Sabbath; the Passover, or Feast of Unleavened Bread; Pentecost, or the Feast of Weeks; the Feast of Trumpets, or New Moon; the Feast of the Atonement; and the Feast of Tabernacles. Afterwards the Feast of Purim (to commemorate the failure of Haman's machinations) and the Dedication of the Temple (after its profanation by Antiochus Epiphanes) were added. Amongst the ancient Greeks were celebrated the Dionysia; the Eleusinia; the four great national games, the Olympic, the Isthmian, the Nemean, and the Pythian. But each community and city had its own local festivals in addition, such as the Panathenæa, held by the tribes of Attica, whose union it was intended to celebrate. Among Roman festivals were the Saturnalia, Cerealia, Lupercalia, and others.

The festivals of the Christian Church owe their origin partly to those of the Jewish religion, such as Easter, which corresponds to the Pass-

over of the Jews, and Whitsuntide, which corresponds to Pentecost; partly also to pagan festivals, which the Christian hierarchy, finding it impossible to abolish them, applied to Christian uses by converting them into festivals of the Church. These festivals are divided into movable and immovable; the former those which in different years fall on different days, the latter those which always fall upon the same day. The chief of the movable feasts is Easter, the one on which the position of all the others, except that of Advent Sunday, depends. Septuagesima Sunday falls nine weeks before Easter, Sexagesima Sunday eight weeks, Quinquagesima Sunday seven weeks, the first Sunday in Lent six weeks, and Palm Sunday one week before Easter. Rogation Sunday falls five weeks, Ascension Day forty days, Whitsunday seven weeks, and Trinity Sunday eight weeks after Easter. Ash Wednesday is the Wednesday before the first Sunday in Lent, Maundy Thursday the Thursday, and Good Friday the Friday before Easter, and Corpus Christi is the Thursday after Trinity Sunday. Advent Sunday is the nearest Sunday to the feast of St. Andrew, 30th Nov., whether before or after. The chief immovable feasts are the feast of the Circumcision on the 1st of Jan., Epiphany on the 6th of Jan., the Annunciation of the Blessed Virgin on the 25th of March, the Transfiguration of Christ on the 6th of Aug.; the feast of St. Michael (Michaelmas) and All the Angels on the 29th of Sept., the feast of All-Saints on the 1st of Nov., the festival of All-Souls on the 2nd of Nov., and Christmas Day or the feast of the Nativity of Our Lord on the 25th of Dec. The festivals relating to the Virgin Mary in the Roman Catholic Church include: the feast of the Annunciation; the Purification of the Virgin, or Candlemas; the feast of the Visitation of Our Lady; the feast of the Immaculate Conception; the Nativity of the Virgin; the Martyrdom of the Virgin Mary; the Assumption of the Virgin (6th Aug.); and several smaller ones. The worship of the Cross introduced two festivals: that of the Invention of the Holy Cross (3rd May), and that of the Exaltation of the Cross (1st Sept.). The saints' days that are still held as festivals, and have religious services connected with them in the Church of England, are called *red-letter* days, because they used to be printed with red letters in the Church calendar; while the saints' days which were still retained in the calendar at the Reformation, but had no services connected with them, are called *black-letter* days, because they were printed in black letters. —BIBLIOGRAPHY: Sir J. G. Frazer, *The Golden Bough*; L. Duchesne, *Christian Worship*; J. Dowden, *The Church and Calendar*. See also J. Rendel Harris, *The Cult of the Heavenly Twins*.

Festus, Porcius, Roman procurator of Judæa A.D. 61–62, successor of Felix. The Apostle Paul appeared before him, and was sent by him to Rome at his own request.

Festus, Sextus Pompeius, a Roman grammarian belonging to the second or third century of our era, author of an abridgment of a work by Verrius Flaccus called *De Verborum Significatione*, a kind of dictionary, which is very valuable for the information it contains about the Latin language. The work of Festus was still further abridged in the eighth century by Paulus Diaconus. The one MS. of the original work of Festus is now at Nuples.

Fétis (fâ'tēs), François Joseph, a Belgian musical composer and writer on music, born 1784, died 1871. He was educated at the Paris Conservatoire; was professor there from 1818 to 1833, when he was appointed director of the Conservatoire at Brussels. Among his works may be mentioned: *Traité de la Fugue* (1825), *Biographie Universelle des Musiciens* (1835–44), *Traité Complet de la Théorie et de la Pratique de l'Harmonie*. His musical compositions include operas, sacred music, and instrumental pieces for the piano and the violin.

Fet'ish, or **Fetich**, a word first brought into use by De Brosse, in his work *Du Culc des Dieux Fétiches* (1760), who was the first to draw attention to fetishism as a branch of the study of religion. The term is derived from the Portuguese *feitico*, magic, a word which expressed the Portuguese opinion of the religion of the natives of the west coast of Africa. The Portuguese gave this name to the idols of the negroes of the Senegal, and afterwards the word received a more extensive meaning. A fetish is any object which is regarded with a feeling of awe, as having mysterious powers residing in it, but without any consciousness in the exercise of them. The fetish may be animate, as a cock, a serpent, &c.; or inanimate, as a river, a tooth, a shell. Fetish worship prevails in Guinea and other parts of the west coast of Africa. In addition to the common fetish of the tribe every individual may have one of his own. To this he offers up prayers, and if they are not heard he punishes it, or perhaps throws it away, or breaks it in pieces.—BIBLIOGRAPHY: E. B. Tylor, *Primitive Culture*; F. Schultze, *Fetichism*; R. H. Nassau, *Fetichism in West Africa*; Sir J. G. Frazer, *The Golden Bough*.

Fetus, or **Fœtus**, the young of viviparous animals in the womb, and of oviparous animals in the egg, after it is perfectly formed; before which time it is called *embryo*.

Feu, **Feu-holding**, or **Feu-farm**, in Scottish law, a special kind of tenure by which land, usually a small piece of ground on which a building or buildings may be erected, is granted

or transferred by the owner to be held perpetually from him as superior, on payment of an annual sum, commonly called the *feu-duty*.

Feudal System, that system by which land (a *fief*) is held by a vassal on condition of fidelity, that is, in consideration of services to be rendered to his superior or feudal lord. The nature of the feudal system is to be explained by its origin amongst the Germanic tribes. In the earliest times the relation of superior and vassal did not exist in connection with the ownership of land. Each freeman had his share of the tribe lands, which were held simply on condition of his fulfilling his public duties of attendance at the councils of the mark or township and performing his share of military service in the wars or musters decreed at such councils. The noble had, of course, more land and more influence than the simple freeman, but there need be no tie of vassalage between them. This seems to have been the primitive social organization of the Anglo-Saxons and other German tribes. The lands held by all freemen, whether noble or ordinary freemen, under this system, are said to be *allodial*, as distinguished from *feudal* lands, which imply service to a superior lord. By the close of the tenth century, however, this system had undergone considerable modifications. The masses of Teutonic invaders who overran Gaul and England had necessarily to confer exceptional powers on their leaders; and as they were for long very much in the position of military in an enemy's country, these powers were naturally continued. Thus it was that kings, before unknown to the Anglo-Saxons, make their appearance immediately after their descent upon Britain. It was common for a chief or great man to have a retinue or body-guard composed of valiant youths, who were furnished by the chief with arms and provisions, and who in return devoted themselves to his service. These companions (O.E. *Gesithas*; Ger. *Gesellen*) originally received no pay except their arms, horses, and provisions, and the portion of the spoils which remained after the chieftain had taken his own share. But when conquered lands came to be apportioned and large districts fell into the hands of kings or dukes and their subordinates, they gave certain portions of the territory to their attendants to enjoy for life. These estates were called *beneficia* or *fiefs*, because they were only lent to their possessors, to revert after their death to the grantor, who immediately gave them to another of his servants on the same terms. As the son commonly esteemed it his duty, or was forced by necessity, to devote his arm to the lord in whose service his father had lived, he also received his father's fief; or rather, he was invested with it anew. By the usage of centuries this custom became a right and the fief

became hereditary. A fief rendered vacant by the death of the holder was at once taken possession of by his son, on the sole condition of paying homage to the feudal superior. Thus a feudal nobility and a feudal system arose and for a time existed alongside of the old allodial system. But gradually the greater security to be got by putting one's self under the protection of some powerful ruler or leader gave the feudal system the predominance. The free proprietor of landed property, oppressed by powerful neighbours, sought refuge in submitting to some more powerful nobleman, to whom he surrendered his land, receiving it back as a vassal. Even the inferior nobility found it to be to their advantage to have themselves recognized as feudatories of the nearest duke or earl; and as the royal power steadily advanced, the offices of duke, ealdorman, *gerefa*, &c., were always bestowed by the king. Thus the Crown became the source of all authority and possession in the country. The land which had once been 'folcland', or the land of the people, became the land of the king, from whom all titles to it were held to be derived. Such at least was the development of feudalism in England, where its centralizing tendencies, especially in the matter of holding land from the Crown, were strongly reinforced by the circumstances of the conquest under William the Norman. Under him and his immediate successors there was a struggle between royalty and the nobility, which ended in the power of the latter sinking before that of the kings. On the other hand, in Germany, France, and elsewhere on the Continent the disintegrating tendencies of feudalism as a system of government had full play. In these countries the weakening of the kingly authority encouraged the great feudal dukes and counts to set up in an almost absolute independence, which in France was afterwards gradually lost as the monarchy grew stronger, but in Germany continued to divide the land down almost to our own times into a number of petty principalities.

Among the chief agencies that overthrew the feudal system were the rise of cities, the change in modes of warfare, and the spread of knowledge and civilization. The spirit of the feudal system, grounded on the prevalence of landed property, was necessarily foreign to cities which owed their origin to industry and personal property, and founded thereon a new sort of power. The growth of this new class, with its wealth and industrial importance, has contributed more than anything else to a social and political development before which the old feudal relations of society have almost totally disappeared. Even yet, however, the laws relating to land still bear the stamp of feudalism in various

countries. In England, for instance, all landowners are theoretically regarded as tenants holding from some superior or lord, though the lord may be quite unknown. See *Middle Ages*. —BIBLIOGRAPHY: C. Seignobos, *Régime féodal en Bourgogne*; Pollock and Maitland, *History of English Law*; J. T. Abdy, *Feudalism: its Rise, Progress, and Consequences*; J. H. Round, *Feudal England*; J. Flack, *Les origines de l'ancienne France*; H. B. King, *A Short History of Feudalism in Scotland*.

Feuerbach (foi'er-bäh), Ludwig Andreas, a German metaphysician, son of the celebrated jurist, was born at Landshut in Bavaria in 1804, died in 1872. After studying theology and philosophy at Heidelberg and Berlin, he became a tutor (Privatdozent) at Erlangen University in 1828. As his negative views in theology were obnoxious to the Government, and thus deprived him of all chance of a professorship, he resigned, and the latter part of his life was passed in straitened circumstances. All transcendental ideas, such as God, immortality, &c., Feuerbach came to regard as deleterious illusions, and considered that the direct contact of the senses with things alone gave the full truth. The conception of God is, according to Feuerbach, merely the projection of man's ideal into the objective world. His works include a *Critique of Hegel* (1839); *The Essence of Christianity* (1841; translated by George Eliot, 1854); *The Essence of Religion* (1849); *Godhead, Freedom, and Immortality* (1866).

Feuerbach, Paul Johann Anselm, father of the preceding, German criminal jurist, was born at Jena in 1775, died in 1833. Having published his first work, entitled *Anti-Hobbes*, in 1798, he began in 1799 to deliver lectures on law at Jena as Privatdozent. In 1801 he became an ordinary professor of jurisprudence at Jena, but the following year accepted a chair at Kiel. In 1804 he obtained an appointment in the University of Landshut, where he was employed to draw up the plan of a criminal code for Bavaria, which received the royal assent in 1813. In 1814 he was appointed second president of the Appeal Court at Bamberg, and in 1817 first president of the Appeal Court for the circle of Regat at Anspach. Among his most interesting and important works are: *Merkwürdige Criminalfälle* and *Themis, or Contributions to the Art of Law-making*.

Feuillants (feu-yän), a religious order which arose as a reform of the order of Bernardines, and took origin in the abbey of Feuillants, near Toulouse, established in 1577. There were also convents of nuns who followed the same reform, called *Feuillantines*. They were suppressed by the revolution of 1789, and their convent in Paris taken possession of by a political club

named the Feuillants, of which Mirabeau was a member. This club consisted of moderate men, who were considered almost as bad as aristocrats by the Sansculotte party. It was broken up after the insurrection of 10th Aug., 1792.

Feuillet (feu-yä), Octave, a French novelist and dramatist, born at Saint L6, department of La Manche, 11th Aug., 1812, died in 1890. He came into notice about 1846 with his novels of *Le Fruit Défendu*, *Le Conte de Polichinelle*, and a series of comedies and tales which was published in the *Revue des deux Mondes*. In 1857 the appearance of *Le Roman d'un Jeune Homme Pauvre* raised Feuillet to the first rank of the novelists of the day. Amongst his other numerous novels are: *Monsieur de Camors* (1867), *Julia de Trécar* (1872), *Le Sphinx* (1874), and *Histoire d'une Parisienne* (1881). His works have a refined humour, and are remarkable for their acute character-drawing and extraordinary penetration. His style is admirably witty and restrained, and perfectly suited to his subject.

Feuilleton (feu-i-ton), that part of a French newspaper devoted to light literature or criticism, and generally marked off from the rest of the page by a line. The feuilleton very commonly contains a tale. The idea originated with the editor of the *Journal des Débats* early in the nineteenth century, and several novels of Dumas, Eugène Sue, and others first appeared as feuilletons. The term is now applied loosely to the serial stories which appear in English newspapers, and which are not uncommonly sensational, often containing a strong love-interest, and including marquesses and earls among their characters.

Fever (Lat. *febris*), a diseased condition of the body characterized by an accelerated pulse, with increase of heat, deranged functions, diminished strength, and often with excessive thirst. Fevers usually commence with chills or rigors, known as the *cold stage* of the disease, although the temperature of the body is really increased. There are also a feeling of lassitude, pains in the back and limbs, loss of appetite, and nausea. This soon develops into the *hot stage*, in which the pulse quickens and the skin becomes hot and dry. These phenomena are accompanied by thirst, headache, a furred tongue, a constipated state of the bowels, and a deficiency in the urinary secretion. The symptoms are generally aggravated at night, and may even be accompanied by slight delirium. After a time the *crisis* is reached, when the patient either dies from gradual exhaustion or from hyperpyrexia, or he begins to recover, the febrile symptoms disappearing sometimes quite suddenly, sometimes very slowly. The loss of strength in fever due to the waste of tissue (caused by the abnormal temperature)

being greatly in excess of the nutritive supply, together with the general disturbance of functions, often brings about fatal results. In many cases fever is only an accompanying symptom of some specific disorder, but in others it is the primary and predominant element, apparently due to some poison operating in the blood. (See *Germ Theory of Disease*.) These primary or specific fevers may be classified as follows:—

1. *Continued fever*, in which there is no intermission of the febrile symptoms till the crisis is reached. Simple fever, or febricula, typhus, typhoid (enteric or gastric) fever are examples. *Relapsing fever* also comes under this head; its chief feature is the recurrence of fever about a week after the subsidence of the symptoms.

2. *Intermittent fever* or *ague*, in which there is a periodic cessation of the symptoms. The varieties are the *quotidian*, occurring every day; the *tertian*, recurring in forty-eight hours; *quartan*, recurring in seventy-two hours or every three days.

3. *Remittent fever*, in which there is a short daily diminution of the symptoms. The condition known as hectic fever and yellow fever belong to this class.

4. *Eruptive fevers*—(1) smallpox; (2) cow-pox; (3) chicken-pox; (4) measles; (5) scarlet fever; (6) erysipelas; (7) plague; (8) dengue fever. See the separate articles.

Fe'verfev (*Pyrethrum Parthenium* or *Matri-caria Parthenium*), a British composite biennial, frequent in waste places and near hedges. It has a tapering root, an erect, branching stem about 2 feet high, and stalked compound leaves of a hoary green colour, and ovate cut leaflets. The plant possesses tonic and bitter qualities, and was supposed to be a valuable febrifuge, whence its name.

Fez, one of the several capitals of Morocco, 100 miles east of the Atlantic and 85 miles south of the Mediterranean. It is finely situated on the hilly slopes of a valley, on the River Fez, which divides Old Fez from New Fez. Both parts are surrounded by walls now in very bad repair. The streets are narrow, dark, and extremely dirty; the houses two or three stories high, and without windows to the street. The interiors, however, are often handsome, the courtyards being paved and provided with fountains. There are many mosques, one of them the largest in North Africa. The Sultan's palace is a large but somewhat dilapidated structure. Fez is a place of considerable commercial importance, being the depot for the caravan trade from the south and east and having extensive dealings with Europe. The manufactures consist of woollen cloaks, silk handkerchiefs, leather, the red caps named *fezes*, carpets, and pottery. Fez was at one time famous as a seat of Arabian

learning. It is considered a holy town by the Western Arabs, and was resorted to by them as a place of pilgrimage when the way to Mecca was obstructed. Founded in 793, Fez was the capital of an independent state from 1202 to 1548, attaining a high state of prosperity. The population is estimated at about 109,000.

Fez (from *Fez*, the above town), a red cap of fine cloth, with a tassel of blue silk or wool on the crown, much worn in Turkey, on the shores of the Levant, in Egypt, and North Africa generally. The core or central part of a turban usually consists of a *fez*. The *fez* is also called *tarbûsh* in Africa.

Fezzan', in the Sahara, formerly a lieutenant-governorship of Tripoli, and thus dependent on Turkey, it forms since 1912 a political division of the Italian province of Tripoli. It is surrounded by mountain chains, and consists of a great number of small oases. There are no rivers or brooks, and few natural springs; but water is found in abundance at various depths, generally from 10 to 20 feet. Rain seldom falls; in some districts it does not rain for years together, and but little at a time. Wheat, barley, millet, figs, melons, and other fruits, tobacco, cotton, &c., are cultivated, but the chief wealth of the country is in its date-palms. With exception of goats and camels, and in some districts sheep and cattle, few domestic animals are reared. There are few manufactures, but there is a considerable caravan trade, Mourzuk, the capital, being the point of junction for caravans from Timbuctoo, Cairo, Tripoli, Sudan, &c. The natives are a mixed race of Arabs, Berbers, and negroes. Pop. estimated at 50,000.

Flacre (fê-ä-kr), in France, a small four-wheeled carriage or hackney-coach, so called from the Hotel St. *Flacre*, where Sauvage, the inventor of these carriages, established in 1640 an office for the hire of them.

Flars Prices, or **Flars** (fê-ärz), in Scotland, the prices of grain for the current year in the different counties, fixed (in accordance with the Act of Sederunt, 1723) by the sheriffs with the assistance of juries, and accepted in certain contracts or agreements where no price has been fixed otherwise.

Fl'at (Lat., 'let it be done'), in English law, a short order or warrant from a judge for making out and allowing certain processes.

Fibres, in botany, the principal strengthening tissues of plants, usually consisting of very long, thick-walled cells with pointed, interlocking ends. Many, such as flax, hemp, jute, ramie, coir, and esparto, are used in the arts for spinning, or for making mats, brushes, paper, &c. Cotton, consisting of the seed-hairs of the cotton plant, is not a fibre in the botanical sense.

Fibres used in Manufacture. The particular

classification of fibres depends partly upon the source from which they are obtained, and partly upon the use to which the fibres are to be put. In the former case the first division is that which separates the animal fibres from the vegetable fibres, and each of these general groups is capable of extensive subdivision. The mineral fibres would also form a class, although a small one, in this division. In the second case, the division is considered from the point of view of the application of the fibres to wholly or partly manufactured products. Most animal and vegetable fibres, including all those of finer quality, are utilized for one or other of the textile industries, while the brush-making industry, which also absorbs a considerable amount of the coarser types of animal and vegetable fibres, as well as some of the finest hairs, is capable of subdivision according to the particular operations involved. With perhaps the exception of natural silk, which is due to the coagulation of a viscous liquid as the latter emerges into the air from the orifices of the caterpillar, all the animal fibres formed originally the outer covering of the skins of various animals.

There is a great variety of wools, from the softest fleece obtained from lambs and from sheep raised on rich soil, to the hard stiff hairs with which deer and similar animals are covered. From the various kinds of sheep alone is derived a very extensive range of wools; indeed, several qualities are obtained from the fleece of every individual sheep, such qualities being sorted out by the wool-sorter and depending chiefly upon the part of the fleece from which the wool is clipped. Considered from the point of view of the fleece, there are the Australian, New Zealand, African, and American wools, each country of which provides many varieties; there are, in addition, numerous European wools, while in Great Britain alone there are varieties which include many types, from the fine valuable South Down wool to the long fibres obtained from the Leicester fleeces, and the useful wools from the highland and mountain sheep. All typical wools have a natural curl or twist, but when the fibre is straight, it is termed a hair. In this latter category one may include the outer covering of the Angora and other goats, which provide us with Mohair, Alpaca, and Cashmere, and finally the camel, cattle, and calves yield valuable hairs for the manufacture of various textile products.

There is quite as much diversity, if not more, in connection with vegetable fibres, which are obtained from three distinct sources: (a) the pod or boll, (b) the stem or stalk, and (c) the leaf. The bolls yield the short fibres of which cotton is the prototype; the second supplies us with the long soft fibres, or bast fibres, such as flax, hemp, jute, and ramie; while the long hard

fibres, e.g. manila, sisal, phormium, are obtained from leaves. Cotton fibres are really seed hairs, and they vary in length from about 1 inch to 1½ inches, while the finest kinds reach 2 inches and a little over. These, as indicated, are obtained from the seed-bolls. Cotton fibres resemble closely a tube flattened centrally in the longitudinal direction, and they have a natural twist which facilitates the spinning process and imparts a valuable resiliency to the finished yarns. The finest and longest fibres are Sea Island and Egyptian, but the great bulk of cotton is grown in the southern states of North America—Georgia, Florida, Texas, Louisiana, and several other states. A considerable quantity of cotton is grown in India, while Central Asia, Africa, and South America help to swell the total crop.

The most valuable long soft vegetable fibres are obtained from the fibrous layer of the flax plant. The stems or stalks are first pulled, then retted, and afterwards dried and broken in order to obtain the bast layer. Then follows the scutching operation, after which the fibre is ready for the first operation in the preparing department of a flax-spinning mill. The length of the flax fibre may be anything from about 2 feet to 3 or 4 feet. In normal times Russia grew and exported by far the largest quantity of flax in the world, and although the quality was very good, it was inferior to that obtained from plants grown and retted in Belgium, Holland, and Ireland. Italian hemp closely resembles the lower grades of flax in fineness, but it is usually much longer, coarser, and stronger than most kinds of flax. Russian hemp is about the same length as flax, and is a valuable fibre for several textile products. Jute, which is also a bast fibre, is coarser still, and grows to a height of 10 to 12 feet and even more. It is a valuable fibre for use in the manufacture of all kinds of fabrics to be used for covering and carrying merchandise; it is also largely used for the foundation of linoleum, and for the manufacture of coal-bags and the like.

Ramie, also called rhea and China grass, is a strong fibre, but rather brittle after it has been made up into yarns for textile purposes. It is whitish in colour, is dyed easily, but often deteriorates in use: it is also hairy, and possesses a good lustre. The chief difficulty in regard to this fibre appears to be that of decortication. One of its chief applications is in the manufacture of gas-mantles, although several kinds of fabrics have been made from yarns spun from this fibre. The hard vegetable fibres, which are usually very long, are obtained from the large leaves of the agave, musa, and other tropical plants, and occasionally from plants grown in semi-tropical areas. The chief use for these fibres is in the

manufacture of ropes and cordage generally. It must be understood, however, that cotton, hemp, and flax, especially the two former, are used extensively for cordage purposes as well as for the usual fine weaving yarns. On the other hand, the hard vegetable fibres are unsuitable for being introduced into fine yarns—indeed they cannot be used for this purpose—but they are admirable for the spinning of binder twine and similar coarse yarns. The best-known long hard vegetable fibres are Manila, sisal, New Zealand flax or hemp (phormium), Mauritiu, and bow-string hems; the last three are leaf fibres, and must not be confused with the real hems obtained from the bast layers of stems or stalks such as Italian hemp, Russian hemp, Indian hemp, and Sunn hemp. The leaves in which the hard vegetable fibres are embedded have to be scraped, either by hand or by semi-mechanical or mechanical means, to remove the vegetable matter from the fibrous layer. The weight of fibre removed equals only about 5 per cent of the total weight of the leaves, and hence there is a considerable number of leaves to be treated for every ton of extracted fibre.

Although Manila and sisal fibres are excellent for the rope and coarse twine-making industry, they are not used in the manufacture of textile fabrics; on the other hand, the better class of phormium (New Zealand hemp) is occasionally prepared and spun into heavy yarns, and subsequently woven into comparatively coarse fabrics resembling the coarse linens made from the lower qualities of flax fibre yarns. There are several varieties of hard vegetable fibres which are somewhat similar in staple to the above-mentioned chief types, and which are used, either alone or mixed with other varieties, in the cordage industry. The fibre known as coir, obtained from the husks or outer covering of coco-nuts, is used in the making of coarse mats and carpetings, while nettle fibre, which came into more or less prominence during the European War, and particularly in Germany, has been utilized, but is comparatively weak.

The successful prosecution of the fibre trade depends partly upon the facilities for growing the plants, but perhaps more on the treatment which is necessary to extract the fibre from its natural covering, while preserving the innate constituents which facilitate the subsequent processes of preparing, spinning, and weaving. In addition to the valuable animal and vegetable fibres, there are mineral fibres, the best known of which is asbestos. In its natural state, the fibre is closely associated with a rock-like substance, and special treatment is necessary to separate the hard substances from the fibre in order to make the latter suitable for conversion into yarns, and ultimately into cloth, which

serves its own particular purposes in the textile world.—BIBLIOGRAPHY: F. H. Bowman, *The Structure of the Wool Fibre*; *The Structure of Cotton Fibre*; W. I. Hannam, *The Textile Fibres of Commerce*; J. Jackson, *Commercial Botany*.

Fibrin, a peculiar organic compound substance found in animals and vegetables. Animal fibrin constitutes the solid matter which deposits when blood coagulates, but it is also furnished by the chyle, lymph, saliva, and by pus and other pathological fluids. Fibrin is composed of carbon, nitrogen, hydrogen, and oxygen, and is closely allied to albumen and caseine. It is a very important element of nutrition. In healthy venous blood there is about 2·8 per cent, but its percentage is slightly more in arterial blood. It is best obtained by switching newly drawn blood with a glass rod or bundle of twigs, when the fibrin adheres to the rod or twigs in threads, and is purified from colouring matter by prolonged washing and kneading with water, and then by treatment with alcohol and ether to remove fat and other substances.

Fibrous Tissue, an animal tissue with a shining silvery lustre, used to connect or support other parts. It is of two kinds, white and yellow (elastic). It forms the ligaments, tendons of muscles, &c.

Fichte (fih'té), Johann Gottlieb, German philosopher, born of poor parents in 1762, died 27th Jan., 1814. After studying at Jena, Leipzig, and Wittenberg, he passed several years as a private tutor in Switzerland and in Prussia Proper, and in Königsberg made the acquaintance of Kant, who showed some appreciation of his talents. His *Versuch einer Kritik aller Offenbarung* (Essay towards a Criticism of all Revelation, 1792) attracted general attention, and procured him the professorship of philosophy in Jena in 1793. In 1800 he was one of the most prominent professors of that university during its most brilliant period. Here he published, under the name of *Wissenschaftslehre* (Theory of Science), a philosophical system, which, though founded on Kant's system, gives the latter a highly idealistic development which was strongly repudiated by the Königsberg philosopher. On account of an article he had written to the *Philosophical Journal* (on the grounds of our belief in the divine government of the world), he fell under the suspicion of atheistical views. This gave rise to an inquiry, which ended in Fichte losing his chair. He then went to Prussia, where he was appointed in 1805 professor of philosophy at Erlangen. During the war between Prussia and France he went to Königsberg, where he delivered lectures for a short time, returned to Berlin after the Peace of Tilsit, and in 1810, on the establishment of the university in that city, was appointed rector and professor of philosophy.

Fichte's philosophy, though there are two distinct periods to be distinguished in it, is a consistent idealism, representing all that the individual perceives as distinct from himself, the *ego*, as a creation of this *I* or *ego*. This *ego*, however, is not the consciousness of the individual so much as the divine or universal consciousness of which the other is but a part. His philosophy thus came to assume a strongly moral and religious character. Amongst his best-known works, besides those already mentioned, are: *System der Sittenlehre* (Systematic Ethics), *Die Bestimmung des Menschen* (The Destination of Man), *Das Wesen des Gelehrten* (The Nature of the Scholar), *Grundzüge des Gegenwärtigen Zeitalters* (Characteristics of the Present Age), *Reden an die Deutsche Nation* (Addresses to the German Nation).—BIBLIOGRAPHY: R. Adamson, *Fichte*; C. C. Everett, *Fichte's Science of Knowledge*.

Fichtelgebirge (fih'tel-ge-bir-ge), a mountain range of Germany, in Bavaria; chief summit, Schneeberg, 3460 feet.

Ficino (fi-chē'nō), Marsilio, an Italian philosopher of the Platonic school, born at Florence in 1433, died in 1499. His early display of talent attracted the notice of Cosmo de' Medici, who caused him to be instructed in the ancient languages and philosophy, and employed him to aid in establishing a Platonic Academy at Florence (about 1460). Ficino amply satisfied his patron, and many excellent scholars were formed under his tuition. His exposition of Plato suffers from his confounding the doctrines of Plato and those of Neo-Platonism.

Fiction, in law, is an assumption made for the purposes of justice, though the fact assumed could not be proved, and may be literally untrue. Thus an heir is held to be the same person as the ancestor to the effect of making the heir liable for the debts of the ancestor. The rules by which the existence of legal fictions are limited have been stated as follows: (1) The fiction must have the semblance of truth. (2) It shall not be used to work a wrong. (3) It shall only be employed for the end for which it was introduced.

Fiddle-wood, the common name of *Citharoxylon*, a genus of trees or shrubs with some twenty species, natives of tropical America, nat. ord. Verbenaceæ. Some of the species are ornamental timber trees; several yield a hard wood valuable for carpentry.

Field, in heraldry, the whole surface of the shield on which the charges are depicted, or of each separate coat when the shield contains quarterings.

Field, Cyrus West, an American merchant, born 1819, died in 1892. Having obtained a charter giving him exclusive right for fifty years

of landing ocean telegraphs on the coast of Newfoundland, he organized an Atlantic telegraph company. Attempts to lay cables were made in 1857 and 1858, but without permanent success, and the American War having broken out it was not till 1866 that a cable was successfully laid by the *Great Eastern*. Field subsequently took an active part in establishing telegraphic communication with the West Indies, South America, and other places, and was connected with various important enterprises.

Field-allowance, an extra payment made to officers of the British army on active service in the field, to compensate partly the enhanced price of all necessaries. These allowances are not made in India.

Field-cricket, *Gryllus campestris*, one of the most noisy of all the crickets, larger, but rarer, than the house-cricket. It frequents hot, sandy districts, in which it burrows to the depth of 6 to 12 inches, and sits at the mouth of the hole watching for its prey, which consists of insects.

Field Engineering is the adaptation of engineering principles to certain of the requirements of an army in the field, viz.: (1) field fortification; (2) bridging; (3) road and rail communications; (4) demolitions; (5) camping arrangements.

Field Fortification.—It is no longer possible, as it was before the European War, to draw a hard-and-fast distinction between field fortification and permanent fortification. On the one hand, the extensive use of such materials as steel and reinforced concrete has given a semi-permanent character to many field works; on the other hand, the power and accuracy of artillery-fire make it a comparatively easy matter to destroy, from a safe distance, a work of restricted extent and known position, no matter how strongly it may be constructed. Entrenchments (q.v.) form the most important feature of the science of field fortification. Obstacles, concealment, and protection from shell-fire are the other aspects of this subject. Obstacles serve a twofold purpose. They enable the defence to exercise a definite (though limited) control over the movements of enemy troops advancing to the attack; and they facilitate the infliction of casualties by delaying the attackers at points swept by short-range fire. An obstacle is of little value unless fire can be directed at every part of it—especially the front edge. For this reason the siting of machine-guns practically determines the siting of obstacles. The function of an obstacle is to entangle and detain the attacker, whilst furnishing him with no cover, either from view or from fire. Barbed wire, being easily transported, quickly erected, and not readily discernible, is the material almost universally employed. When secured to pickets

driven into the ground, it always has some value, even after severe bombardment. The trace of an obstacle should not be parallel to the trenches, but arranged in bold zigzags. By this means the defence is enabled to sweep the front of the obstacle with fire; wire-cutting by the hostile artillery is made more difficult; and the enemy's attack formations are disorganized at the most critical moment.

Concealment may be achieved either by screening an object from view or by camouflage. Screening, being obvious to the enemy, is only effective when the track, trench, or position so concealed is of large extent, or is in periodic, rather than continuous, usage—provided always that the screen can be maintained in good repair. The tactical value of screening is proportionate to the extent to which the enemy's fire is thereby converted from aimed fire to unaimed fire. Camouflage aims at concealing from the enemy the fact that an attractive target lies within his field of vision. A successfully camouflaged object will, from the enemy's point of view, either present the semblance of some innocent and familiar feature of the landscape, or will be indistinguishable from its surroundings.

Protection from shell-fire is provided in varying degrees. Splinter-proof shelters carry some two-feet thickness of earth overhead, and accommodate about six men apiece, giving them complete protection from shrapnel, but no protection against a direct hit by even a small shell. Twenty-feet thickness of earth is required to make a shelter proof against a direct hit. The labour involved limits the scale on which such accommodation can be provided.

Bridging.—Most military bridges are built either to replace ones which have been destroyed, or to supplement existing bridges, so as to enable the roads to carry the increased military traffic. A comparatively small proportion are built, under fire, by an army engaged in forcing a crossing. For this latter purpose a light type of bridge is used, designed to carry infantry, cavalry, and field artillery; very light foot-bridges, for infantry only, are often made in the first instance. Medium and heavy bridges are designed to carry lorries, motor-buses, and heavy artillery; they require more deliberate construction, which cannot be done under close fire. Heavier types still are needed for large tanks and railways. The mobile (pontoon) bridging equipment of an army is intended, primarily, for light tactical bridges, but can also be used for medium and heavy types. A few steel bridges, especially designed for speedy erection and lightness of individual parts, are usually held in reserve for emergency use as medium and heavy bridges.

Siting of light bridges is determined by tactical

considerations; that of heavier types by the requirements of traffic control. All military bridges are constructed, in the first instance, for single traffic; arrangements for traffic control are therefore necessary as soon as any bridge is completed. The approaches need careful preparation, to obviate any crowding on the bridge; they should be level for at least three yards, and well metalled or timbered. There are three kinds of bridges: (1) single-span; (2) those with floating intermediate piers of pontoons, boats, &c.; (3) those with fixed intermediate piers of trestles, piles, &c. The last two kinds are often combined.

The roadway consists of decking, carried on road-bearers, which rest on transoms (the top beams of the piers). The decking is held down at its edges by ribands, which also serve as wheel-guides. Hand-rails are always provided; screens also are necessary if the bridge crosses running water or a deep gap, and is to be used by transport animals. A plank, 2 inches thick, suffices to carry infantry across a gap of 8 feet; beyond this width intermediate supports are needed. Floating bridges furnish the best means of getting troops across gaps more than 14 feet wide. Rafts are useful when the material available is insufficient to form a bridge. Fixed piers are generally timber trestles or cribs. The transom of a trestle is supported on timber uprights cross-braced to one another; each trestle must also be cross-braced to the adjacent trestles. A crib-pier is a four-square stack of logs, built up after the fashion of a log-hut. It is easily made and needs no cross-bracing, but it requires an excessive amount of timber.

Road and Rail Communications.—Existing railways and roads in a theatre of war are subjected to a vastly heavier traffic than that for which they were designed. Repairs become incessant and add to the congestion. New railway and road construction must usually be undertaken, but is slow in coming to fruition. Tramways and cross-country tracks are more quickly made, and will carry much of the traffic. Cross-country tracks are made for men, for pack-transport, and for horsed transport. Infantry tracks usually consist of the wooden gratings known as trench-boards, laid on small sleepers to form a pathway 3 feet wide. Mule tracks are made 5 feet wide on an earth formation. They must be sited well away from the infantry tracks, or the temptation to lead mules along the latter will be irresistible. Earthen tracks, 18 feet wide, are marked out for horsed transport on the best ground available; they can only be used in fine weather.

Demolitions.—Demolitions suggest explosives. These, indeed, furnish the best means of attacking roads and railways, but there are many other

ways of destroying material which is in danger of falling into the hands of the enemy. Forage, &c., can be burnt; certain stores can be made useless by the application of water; machinery can be broken up with hammers, or rendered ineffective by the removal of important parts. Roads and railways are best attacked at bridges, causeways, tunnels, crossings, cuttings, and embankments. The easiest way of disabling rolling-stock is to remove or destroy the whole supply of one article which is essential to the working of the railway. Effective damage to the permanent way can only be achieved at great expense of time and labour. Explosives must be placed in close contact with the object to be destroyed, and may be fired either electrically or by time-fuse. Tamping the charges by packing earth closely around them greatly increases the explosive effect. High explosives, like dynamite and T.N.T., have a shattering effect; low explosives, like gunpowder and cordite, have a lifting or propelling effect.

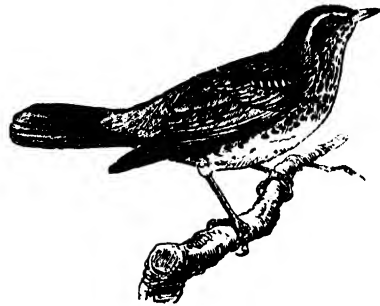
Camping Arrangements.—Dry, grassy slopes furnish the best sites for encampments, but water-supply and tactical considerations usually determine the choice of site. Men and animals need protection, not only from the weather, but also from bombing aeroplanes. The latter form of protection is provided by low traverses or parapets, designed to limit the horizontal travel of bomb splinters. Water is derived from streams, wells, and ponds. The best supply is reserved for drinking and cooking purposes; watering of animals has the next claim; a supply for washing purposes has also to be found. Drinking-water is purified by the addition of a small quantity of chloride of lime. A field kitchen is quickly made by scooping out a narrow trench and lighting a fire in it. The food is cooked in mess-tins, laid in a row on top of the trench. Sanitary measures are necessary to protect the water-supply and to prevent contamination of food by flies.

Fieldfare, a bird of the thrush genus (*Turdus pilaris*), about 10 inches in length, the head ash-coloured, the back of a deep chestnut, and the tail black. They pass the summer in the northern parts of Europe and Asia, but visit Britain in the winter.

Field-glass, a short double telescope of which the two parts are the same in construction, and are placed parallel to each other so that the axes of the eye-lenses are at the same distance apart as the pupils of the observer's eyes. In the Galilean type of field-glass, the objectives are convex and the eyepieces concave lenses, and the distance between these in either tube is, when least, equal to the difference of their focal lengths; this accounts for the shortness of the instrument. In a telescope with a convex

eyepiece, the minimum lens distance is the sum of the focal lengths. By the use of 90° prisms, however, employing double-internal reflection, the rays which enter the objective traverse the tube three times before issuing through the eyepiece. This has the effect of shortening the instrument. Also the prisms cause a double-lateral inversion, which produces an erect image. The prismatic field-glass does not give such a bright image as the Galilean, partly on account of the loss of light by reflection at the glass surfaces, and partly because of the greater magnification employed.

Fielding, Anthony Vandyke Copley, English painter in water-colours, born about 1787, died in 1855. He early attracted attention by his water-colour landscapes, and for fourteen years



Fieldfare (*Turdus pilaris*)

before his death was president of the Society of Painters in Water-colours. His pictures are chiefly taken from English scenery, the various features of which, both in rich woodland and open plain, he has represented with great delicacy and truth, although afterwards falling into mannerism and self-repetition. His oil-painting was not a success.

Fielding, Henry, first in time and importance of British novelists, was born at Sharpham Park, near Glastonbury, in Somerset, on the 22nd April, 1707. His father was Edmund Fielding, afterwards a major-general, who belonged to a younger branch of the family of the Earl of Denbigh. He was educated at Eton, where he remained possibly until 1725. In that year he had a precocious love-affair with Miss Sarah Andrew of Lyme Regis; this lady married a Mr. Rhodes in the following year, and Fielding soothed his wounded feelings by translating parts of the Sixth Satire of Juvenal (The Legend of Bad Women). Fielding began his literary career by writing a large number of farces, comedies, and burlesques. This work he frankly regarded as hack-work, and while almost all his plays have good passages in them, none are of great importance in comparison with his novels. His first

comedy, *Love in Several Masques*, was produced at Drury Lane 12th Feb., 1728. Fielding then went to the University of Leyden, where he was admitted 16th March, 1728, and where he remained until about Feb., 1730. In 1730 one of his most successful burlesques, *Tom Thumb*, was produced at the Haymarket. A revised and enlarged version of it was brought out the next year, under the name of *The Tragedy of Tragedies*. Fielding based several of his plays on Molière—*The Mock Doctor* (1732) on *Le Médecin malgré lui*, and *The Miser* on *L'Avare*. In 1734 he produced *Don Quixote in England* at the Haymarket—a work unimportant in itself, but showing Fielding's keen appreciation of Cervantes. On 28th Nov., 1734, he married Miss Charlotte Cradock of Salisbury, who was the original of Sophia Western in *Tom Jones*, and of the heroine in *Amelia*. For a while he seems to have lived beyond his means at East Stour, in Dorsetshire, but soon returned to his business of playwright. *Pasquin* (1736) and *The Historical Register* (1737) were two most successful burlesques which turned the ministry into ridicule. So successful were these pieces that the ministry hastened to pass a Licensing Act which effectually muzzled Fielding. He entered the Middle Temple on 1st Nov., 1737, and was called to the Bar in June, 1740. We can infer that he was a diligent student of law, and was determined to succeed in his profession.

In 1740 Samuel Richardson published his novel *Pamela*. Fielding saw that it would be amusing to burlesque this novel by writing in a similar manner about a hero instead of about a heroine, and so ridicule Richardson's somewhat namby-pamby morality. It is possible that Fielding may have got a hint for the idea of his virtuous male from Aristophanes' *Plutus*, line 1091. Fielding collaborated with Rev. William Young, the original of Parson Adams, in translating the *Plutus* (published June, 1742). At any rate *The History of the Adventures of Mr. Joseph Andrews, and of his friend Mr. Abraham Adams* appeared in Feb., 1742. It ran far beyond its original design of being a burlesque, and became a novel of life and manners. Some of its characters, Mrs. Slipslop, Parson Trulliber, and above all Parson Adams, are among the greatest characters in fiction. Joseph Andrews (who was named after the Biblical Joseph) and Fanny get pushed into the background to make way for characters of less importance to the plot. In *Joseph Andrews* Fielding was still feeling his way as a novelist, but it has an inimitable freshness and charm.

In 1743 Fielding published a volume of *Miscellanies*. This contained the Lucianic *Journey from this World to the Next*, and the much more memorable *History of the Life of the Late Mr.*

Jonathan Wild the Great. The latter is probably the greatest piece of sustained irony in English literature, greater even than anything in Swift. It has always been caviare to the general, as irony in large doses does not entertain the majority of mankind. Fielding's wife died in 1743, and he married in 1747 one Mary Daniel, reputed to have been his first wife's maid. She made him a good wife. In 1748 he was appointed Justice of the Peace for the County of Middlesex, and for the City and Liberty of Westminster.

Fielding's career up to this point had fitted him to become a great novelist. He had lived a full life, and had seen the world from many different angles. He had been educated abroad, he had done useful journeyman work as a playwright, he had lived as a country squire, and he had become a lawyer. Also he had made himself familiar with the ancient and modern classics, and he admired what was best among them, Aristophanes, Lucian, Shakespeare, Molière, Cervantes, and Le Sage. In 1740 (28th Feb.) he produced his masterpiece, *Tom Jones*. To praise this, "the labour of some years" as he called it, is superfluous. Coleridge said that it had one of the three best plots in the world; and Byron called its author "the prose Homer of human nature". It is, indeed, a vast sort of comic prose epic, varied as life itself is varied. The introductory chapters in particular are models of good style and good sense.

The third and last of the three great novels, *Amelia*, was published in Dec., 1751. It has a mellowness that is all its own, but it is hardly as good as *Tom Jones*. Even the mind of such a man as Fielding could only yield one such harvest. *Amelia*, however, is extremely good, and would probably be rated higher were it not overshadowed by its greater predecessor. Fielding did not write much more, save a few pamphlets mostly on economic or legal subjects. In one of them he defended the notorious Elizabeth Canning. His health began gradually to break up. In June, 1754, he left England and went to Lisbon to try to recover his health, but he did not succeed in so doing, and died 8th Oct., 1754. He was buried in the English cemetery at Lisbon, where a tomb was erected in 1830. *The Journal of a Voyage to Lisbon* was posthumously published. It is a charming account of his last voyage, where we can see the indomitable pluck of the man who was dying when he left England, and who was always courteous and considerate of others.

Henry Fielding is not only witty in himself, but the cause that wit is in other men. His novels have been used as models by almost all the most distinguished of his successors. No one, however, has beaten him at his own game, although those who have loved him most have

been most successful as novelists. In many respects he stands nearest to Shakespeare among English authors. Shakespeare, however, was not of an age, but for all time, while Fielding is more limited in his scope. Fielding is a typical Englishman; he is English as good ale and roast-beef and fox-hunting are English. But in his breadth of view, in his kindly tolerance, and in his unfailing sympathy for human frailty he is Shakespearean. His novels have had a healthy influence on all subsequent fiction. His tolerance and his broad open-air humour are a sure cure for a mind diseased by the psycho-analytic and morbid fiction of a more recent period.—BIBLIOGRAPHY: Austin Dobson, *Fielding* (English Men of Letters Series); G. M. Godden, *Henry Fielding: a Memoir*; W. L. Cross, *The History of Henry Fielding*; Sir Walter Raleigh, *The English Novel*; W. M. Thackeray, *The English Humourists of the Eighteenth Century*; W. Hazlitt, *Lectures on the English Comic Writers*; Sir L. Stephen, article *Fielding* in *Dictionary of National Biography*.

Field-marshal, the highest military dignity in Britain, Germany, France, and other countries. In Britain the dignity is conferred by selection and enjoyed by but a very few officers, and chiefly for distinguished services or on the ground of royal descent. It was introduced into Britain by George II in 1736. In 1921 the following personages bore the title of field-marshal in the Army List: the Duke of Connaught, Lord Grenfell, Lord Methuen, Earl French, Earl Haig, Sir C. C. Egerton, the Emperor of Japan, Marshal Foch, Lord Plumer, Viscount Allenby, Sir H. H. Wilson, and Sir W. R. Robertson. In France the analogous dignity of *maréchal de France* was abolished in 1888, but was again revived during the European War, when General Joffre was created a *maréchal de France*, as also were Foch and Pétain.

Field-officers, in the army, those competent to command whole battalions—majors, lieutenant-colonels, colonels, as distinguished from those entrusted with company duties, as captains and lieutenants.

Field of the Cloth of Gold, a spot in the valley of Andren, between the English castle of Guisnes and the French castle of Ardres, celebrated for the meeting (7th June, 1520) between Henry VIII of England and Francis I of France, attended by the flower of nobility of both nations. The diplomatic results were little or nothing, and the event is now memorable only as a grand historic parade.

Fierasfer, a genus of small eel-like shore fishes of warm seas, often living as commensals within holothurians, star-fishes, and bivalve molluscs.

Fī'eri Fa'cias, a writ in English law for en-

forcing judgment against the goods of a debtor. The term is commonly contracted *Fi. Fa.*

Flery Cross, among the Scottish Highlanders, a cross of light wood, the extremities of which were set fire to and then extinguished in the blood of a goat, sent from place to place as a summons to arms. Also known as the *Crantarn*.

Fieschi (fi-es'kē), Joseph Marco, conspirator, born at Murato, in Corsica, in 1790. He served for some years in the French army, and in the Neapolitan army of Murat. Having returned to his native land, he was convicted of robbery and sentenced to ten years' imprisonment. After the revolution of 1830 he appeared in Paris, and by means of forged papers obtained a small pension and an appointment under the pretence that he had been a victim of the Restoration. Being afterwards deprived of his appointment, he resolved to avenge the slight by assassinating Louis-Philippe, which he attempted by an 'infernal machine' on 28th July, 1835. The king escaped with a slight scratch, although a number of persons around him were killed. Fieschi was guillotined 19th Feb., 1836, along with two of his accomplices.

Fiesole (fi-es'o-lā; anciently *Fæsulæ*), a small town of Italy, 3 miles north-east of Florence, on the top of a steep hill. It has a cathedral and is the seat of a bishop. Anciently it was an important Etruscan city, and still has some Etruscan remains. Pop. about 4000.

Fiesole, Fra Giovanni da. See *Fra Angelico*.

Fife, a small instrument of the flute kind, pierced with six finger-holes, and usually having one key. Its ordinary compass is two octaves from D on the fourth line of the treble staff upwards.

Fife, or **Fifeshire**, a maritime county, Scotland, forming the peninsula between the Firths of Forth and Tay; extreme length, 43 miles; extreme breadth, 17 miles; area, 322,844 acres. The surface is pleasantly undulating. The principal elevations are the Lomond Hills, whose highest summit is 1720 feet above sea-level. The principal valley, called Strath Eden or the 'Howe (hollow) of Fife', watered by the Eden, is very fertile, highly cultivated, and thickly studded with beautiful mansions and villas. Very fertile also is the district lying along the shores of the Firth of Forth, and remarkable for the number of towns and villages with which it is lined. But the north-eastern part, between St. Andrews and the Tay, which is mostly a wet clayey soil, and the north-western part, mostly rock and moor, are in general cold and poor. Fife is the second largest coal-producing county in Scotland. Iron, limestone, and freestone abound. The chief manufacture is linen, especially damasks, diapers, &c., principally at Dunfermline; floorcloth is largely made, more especi-

ally at Kirkcaldy. There are salmon and other fisheries. The principal towns are Kirkcaldy, Dunfermline, and St. Andrews; Cupar is the county town. Fife returns two members to the House of Commons, being divided into an eastern and a western division. Pop. 292,902.

Fife Ness, the eastern extremity of Fife, about 2 miles from Crail. Near it is a dangerous ridge of rocks known as the Carr Rocks, on which a beacon has been erected.

Fifth, in music, an interval consisting of three tones and a semitone. Except the octave it is the most perfect of concords. Its ratio is 3 : 2. It is called the fifth, as it comes, by diatonic ascent, in the fifth place from the fundamental or tonic.

Fifth-monarchy Men, a sect of politico-religious enthusiasts who during the Protectorate of Cromwell assumed to be "subjects only of King Jesus". They considered the revolution as the introduction to the *fifth* great monarchy which was to succeed to the four great kingdoms of Antichrist mentioned by Daniel (the Assyrian, the Persian, the Grecian, and the Roman), and during which Christ was to reign on earth 1000 years.

Fig (*Ficus Carica*), a deciduous tree belonging to the ord. Moraceæ (mulberries). It is indigenous to Asia Minor, but has been naturalized

The fruit is a hollow receptacle produced in the axils of the leaves on small round peduncles, and containing a great multitude of minute flowers, the ripe carpels of which are embedded in the pulp. The flowers are male and female, the former situated near the orifice at the top, the latter in that part of the concavity next the stalk. Figs, particularly dried figs, form an important article of food in the countries of the Levant. The best come from Turkey.

Fig'aro, a dramatic character first introduced on the French stage by Beaumarchais in his comedies *The Barber of Seville* and *The Marriage of Figaro*. Figaro is a barber remarkable for his shrewdness and dexterity in intrigue. The plays were adapted for Mozart's *Marriage of Figaro* and Rossini's *Barber of Seville*. The name is also well known as that of the famous French journal, started in 1826, suspended in 1833, and revived in 1854.

Fig'eac (fê-zhák), a town of France, department of Lot, 42 miles E.N.E. of Cahors. It is an ancient place, and consists chiefly of narrow crooked streets and antiquated houses with quaint Gothic fronts. Pop. 5800.

Fighting-fish (*Betta pugnax*), a small spiny-finned fish, native to the south-east of Asia, and remarkable for its pugnacious propensities. In Siam these fishes are kept in glass globes, as we keep gold-fish, for the purpose of fighting, and an extravagant amount of gambling takes place about the result of the fights. When the fish is quiet, its colours are dull; but when it is irritated, it glows with metallic splendour.

Figueras (fi-gá-räs), a town of Spain, in the province of and 21 miles N.N.E. of Gerona, near the French frontier, defended by a fortress reputed the strongest in Spain. Pop. 11,778.

Figurate Numbers, in mathematics, series of numbers used by actuaries in calculations of annuities in which the annual payment is variable. The first set is $1 + 1 + 1 + 1 + \dots$, the second $1 + 2 + 3 + 4 + \dots$, the third $1 + 3 + 6 + 10 + \dots$; and generally the n th set is the series of coefficients of $(1 - x)^{-n}$ by the Binomial Theorem, viz.

$$1 + n + \frac{n(n+1)}{1.2} + \frac{n(n+1)(n+2)}{1.2.3} + \dots$$

The n th number in any set is the sum of the first n terms of the preceding set, e.g. $10 = 1 + 2 + 3 + 4$. The n th number in any set is also equal to the sum of the number before it in its own set and of the n th number in the preceding set, e.g. $10 = 6 + 4$.

Fig-worts, the common name of Scrophularia, and sometimes also applied to the Scrophulariaceæ, a large nat. ord. of gamopetalous Dicotyledons, represented by the calceolaria, fox-glove, veronica, &c.



Fruiting Branch of Fig

in all the countries round the Mediterranean. It grows from 15 to 20 or even 30 feet high. In congenial climates it bears two crops in a season, one in the early summer from the buds of the last year; the other (which is the chief harvest) in the autumn, from those on the spring growth.

Fiji, or Viti, Islands, an island group, South Pacific Ocean, east of the New Hebrides, between lat. 15° 30' and 19° 30' s.; and long. 177° e. and 178° w. The entire group, which was discovered by Tasman in 1643, comprises altogether about 250 islands and islets, eighty of which are inhabited; total area, about 7083 sq. miles. Two of the islands only are of large size, namely, Viti Levu, 90 miles long by 60 miles wide; and Vanua Levu, rather longer but much narrower and more irregular. Next to these come Taviuni and Kandavu. The islands are of volcanic origin, extremely fertile, and covered with a luxuriant foliage, especially on the east side. The peaks are usually basaltic cones or needles, some of which rise to the height of several thousand feet. The coasts are almost surrounded with coral reefs, and where the shore is not precipitous the beach is formed of fine coral sand. The coco-nut palm grows along the sea-coasts; the bread-fruit, banana, and pandanus are abundant; the orange, taro, yams, sweet-potato, and since the commencement of European settlements, maize, tobacco, and the sugar-cane are cultivated; timber trees, including the chestnut, are plentiful; sandal-wood is now scarce. The birds are wild ducks, pigeons, the domestic fowl, parrots, and other tropical species. Except the stock introduced there are hardly any animals. Fish are plentiful. The natives enclose and cultivate their lands, the women performing most of the manual labour. The climate on the whole is healthy and agreeable for Europeans. The Fijians are a dark-coloured, frizzly-haired, bearded race of Melanesian extraction, although intermixed with the Polynesians of Tonga and Samoa. They are cleanly in their habits, and are generally regarded as superior to the Polynesians in intelligence. Their early character, however, was bad. Cannibalism was reduced to a system, and wives, children, and friends were often sacrificed to the fondness for human flesh. Cannibalism, however, is now abolished. This result has been due to the Christian missions, mostly Wesleyan, which have been very successful, most of the native population having become professed Christians. From 1866 onwards the influx of European settlers from New Zealand and the Australian colonies gradually brought the trade of Fiji into importance, and repeated applications were made to the British Government both by the settlers and the king, Thakombau, to annex the islands. At length in 1874 this was done, and the Fiji Islands were made a Crown colony, under a Governor, assisted by an executive council consisting of the Colonial Secretary, the Attorney-General, and members nominated by the Governor. The Legislative Council, which is presided over by the Governor, consists of

twelve nominated members, seven elected members, and two native members. Native chiefs take part in the administration, the old customary law being still largely adhered to. Since the annexation the prosperity of the colony has been remarkable. The revenue in 1918 was £371,189: the imports and exports in 1918 were £1,166,367 and £1,656,065 respectively. The chief article of export is sugar; the next is copra, the dried kernels of the coco-nut. The other important exports are cotton, molasses, and coffee. The demand for labour led to the introduction of some 17,000 coolies from India. In 1911 the population was 189,541, of whom 3707 were Europeans. The capital is Suva, on the south coast of Viti Levu. The island of Rotumah, to the north, was annexed to Fiji in 1881.—BIBLIOGRAPHY: Calvert and Williams, *Fiji and the Fijians*; B. Thomson, *The Fijians*; Waterhouse, *Fiji: its King and People*.

Filangieri (li-làn-ji-ā'rē), Gactano, Italian writer, born of a noble family in 1752, died in 1788. He studied law, and soon became distinguished in his profession by his learning and eloquence. His life was mainly devoted to a great work, *La Scienza della Legislazione* (The Science of Legislation), which was characterized by great fearlessness of speech in the advocacy of reforms, and was condemned by an ecclesiastical decree in 1784.

Filbert, the fruit of a cultivated variety of *Corylus Avellana* or hazel. See *Hazel*.

Fildes, Sir Luke, portrait and genre painter, was born in Liverpool in 1844, and received his artistic education at the South Kensington and Royal Academy Art Schools. His earliest productions were sketches in black-and-white for the *Graphic*, *Illustrated London News*, *Cornhill Magazine*, and other periodicals, and after being chosen to illustrate the last works of Dickens and Samuel Lover, he took to painting. His first picture was *Nightfall* (1868), and since then he has exhibited: *The Loosened Team*; *The Empty Chair*; *Fair, Quiet, and Sweet Rest*; *Simpletons*; *Applicants for Admission to a Casual Ward*; *The Widower*; *The Return of the Penitent*; *The Village Wedding*; *Venetian Life*; *The Al-Fresco Toilette*; *The Doctor*; *Portraits of the Duke and Duchess of York* (for the *Graphic*, 1893); also state portraits of the King (1902), and of the Queen (1905). Several of his paintings, and in particular the famous *Casual Ward*, show powers of realism in painting not unlike those of Dickens in fiction; but his later works are more striking from their colour-effects. A.R.A. in 1879, a full Academician in 1887, he was knighted in 1906, and created a K.C.V.O. in 1918.

File, a bar of cast steel with small sharp-edged elevations on its surface called teeth, the use of which is to cut into or abrade metals,

wood, ivory, horn, &c. Files are of various shapes, as flat, half-round, three-sided, square, or round, and are generally thickest in the middle, while their teeth are of various degrees of fineness and of different forms. A file whose teeth are in parallel ridges only is called *single-cut* or *float-cut*. Such are mostly used for brass and copper. When there are two series of ridges crossing each other, the file is *double-cut*, which is the file best suited for iron and steel. *Rasps* are files which have isolated sharp teeth separated by comparatively wide spaces, and are used chiefly for soft materials such as wood and horn. Each of these three classes of files is made in six different degrees of fineness, the coarsest being called *rough*, the next *middle*, followed by *bastard*, *second-cut*, *smooth*, and *superfine* or *dead-smooth*, each a degree finer than that which precedes it.

File-fish, the name applied to species of *Balistus*, which is the type of a family (*Balistidae*) including marine fishes living in warm and tropical seas. They may attain a length of 3 feet, and are invested in an armour of lozenge-shaped bony plates. By means of their strong front teeth they can break off pieces of coral and crush the shells of bivalve molluscs. The first dorsal spine is roughened in front like a file, and the second spine is attached to it in a way suggesting the alternative name of 'trigger fish'.

Filey, a watering-place of England, on the coast of the East Riding of Yorkshire, $7\frac{1}{2}$ miles s.e. of Scarborough. It has a fine old Norman and Early English church, which stands on an eminence. The sands are very firm and good, and there are salt springs. Pop. (urban district), 4549.

Filibusters, a name given to those adventurers, chiefly from the United States, who endeavoured to effect settlements on the Spanish islands and colonies in Central America. The term is probably derived from the Dutch *vry buiter*, English *freebooter*, through the Spanish *filibustero*. Among the most noted of the filibusters was William Walker, who made three expeditions to Nicaragua (1855, 1857, 1860).

Filicaja (fi-li-kä'yä), Vincenzo da, an Italian poet, born in 1642 at Florence of a noble family, died in 1707. The publication of his odes, sonnets, &c., in 1684 established Filicaja's fame as the first poet of his time in Italy. The Grand-Duke of Tuscany appointed him Governor of Volterra, and then of Pisa, in which posts he gained the esteem equally of people and sovereign. Among his most successful poems are the *Canzone to John Sobieski* on the occasion of the relief of Vienna from the Turks, and the celebrated sonnet on Italy, imitated by Byron in the 4th canto of *Childe Harold*, stanzas 42, 43.

Filicales. See *Ferns*.

Filigree, a kind of ornamental open work in gold or silver, wrought delicately in the manner of little threads or grains, or of both intermixed. The art was practised by the Etruscans and the Greeks of the Byzantine Empire. In the seventeenth century it was carried to great perfection in Italy, and silver filigree work is still largely manufactured in the south of Europe. Some of the Eastern nations, especially the Chinese and Malays, show great skill in the manufacture of silver filigree.

Fillan, St. Two saints of this name, who flourished in the seventh and eighth centuries, appear in the Church calendars.—(1) *St. Fillan*, or *Faolan*, the leper, whose annual festival is the 20th June. His principal church in Scotland was at the lower end of Loch Earn, in Perthshire, where 'St. Fillan's Well' was long believed to have wonderful healing properties.—(2) *St. Fillan*, the abbot, the son of St. Kentigerna in Incheallach, in Loch Lomond, had his chief church also in Perthshire, in Strathfillan, the upper part of Glen Dochart. The silver head of this abbot's crozier, entrusted by King Robert Bruce to the Dewar family, is now in the Antiquarian Museum, Edinburgh.

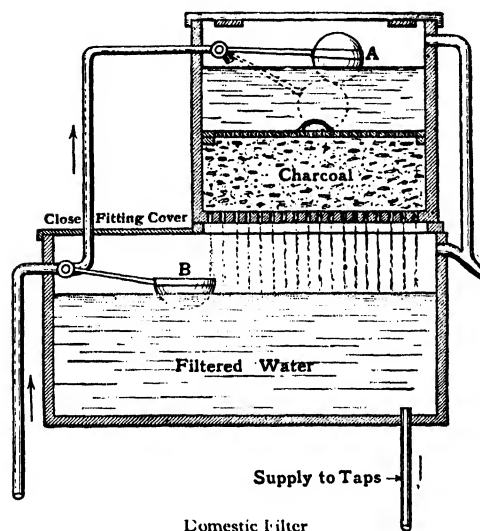
Fillet, in architecture, a small moulding, generally rectangular in section, and having the appearance of a narrow band, generally used to separate ornaments and mouldings.

Fillmore, Millard, thirteenth President of the United States, born 1800, died 1874. He began his political career in 1829; was member of Congress in 1832, and in 1848 became Vice-President of the United States. By the death of Zachary Taylor, Fillmore was raised to the office of President, which he held till 1853.

Filmy Ferns (*Hymenophyllaceæ*), an order of ferns requiring a damp and shady spot to live in. They are chiefly found in tropical regions, the two species (*Hymenophyllum tunbridgense* and *H. unilaterale*) found in Great Britain being the most widely distributed. They owe their filmy appearance to the fact that the tissue of their fronds is composed, as in mosses, of only a single layer of cells, and is being continually saturated with moisture. They are usually grown in bell-glasses, or in specially constructed cases.

Filtration, the process of freeing a liquid from solid matter suspended in it by causing it to pass through some pervious substance or substances which catch and retain the solid matter. The materials of which a filter is composed must have pores or interstices sufficiently coarse to allow the passage of the liquid, and yet sufficiently fine to prevent the passage of any solid particles. On a small scale unsized paper is often used; on a large scale various

kinds of stone, sand, gravel, powdered glass, clay, charcoal, coke, &c., are employed. In domestic filters the simplest forms are those in which the water passes down by gravity through the filtering medium to a reservoir below. Lateral and ascending filters are not uncommon. Filtration can be hastened by applying suction or pressure. The latter method is used in the Pasteur-Chamberland filter, consisting of a hollow cylinder of porous porcelain, which can be attached to an ordinary water-tap, the water being thus forced through the pores. The filters at waterworks are large tanks or beds, filled with layers of large stones, pebbles, coarse gravel, fine gravel,



coarse sand and fine sand—the fine sand being at the top. Other materials are sometimes utilized, such as furnace cinders or clinkers, shells or shell-sand, and so forth. The water in the reservoir, collected from springs, streams, and ruin, is allowed to deposit its suspended matter in settling-tanks, and then it is run into the filters. By percolation the rest of the mineral matter is removed, and the water then flows into the pipes which are to convey it to the locality where it is to be used. Pressure filters are now in use by waterworks companies, consisting of large steel drums 6 to 10 feet in diameter, by 6 feet high, containing the filtering media on perforated trays, through which the water is forced. These filters have a high efficiency both as regards the quantity of water dealt with and the percentage of solids in suspension removed. They are cleaned by reversing the flow of water, and discharging through suitable drains.

Finance may cover either 'public finance'

or 'commercial finance'. By public finance is meant the measures taken by Governments, whether national or local, for the purpose of raising money to pay for the national or local services run by governmental agencies. Public finance is, therefore, an essential part of the functions of any Government. Its sphere varies in accordance with the activities of the Government in question. During a time of peace, and under an individualist régime, a national Government may have to find money only for the services of justice and order, for limited activities in the interests of public health and of national commerce and industry, and for a small army and navy. In such circumstances public finance will not play a large part in the life of the State. Such conditions, however, are now rare, and most Governments spend large sums on public education and health, and on works of public development, while the demands of national defence entail heavy expenditure. Such was the state of things in most civilized countries prior to 1914, when the problem of raising sufficient revenue to meet State expenditure was growing increasingly difficult, and was giving rise to vexed discussions as to the proportion of revenue which should be contributed by owners of wealth paying 'direct taxes', levied on them in proportion to their capital wealth or money income, or by consumers paying 'indirect taxes' levied on commodities, in the form of internal excise or of import duties. In the United Kingdom 45 per cent of the national revenue was raised by direct taxation, and 43 per cent by indirect taxation in 1913, the proportion in 1920 being 48 per cent and 25 per cent respectively. The difficulty of making both ends meet has been much intensified in all countries which took part in the war of 1914-8 by the gigantic expenditure caused by the war. A serious burden of war debts remains. The National Debt of the United Kingdom, and the 'debt charges' (including sinking fund for the reduction of the debt) amounted in 1913-4 to £651,270,091 and £24,500,000 respectively. The corresponding figures in 1920-1 were £7,644,000,000 and £349,598,616. In this country national finance is regulated by the 'Budget', which is in effect a balance sheet of estimated revenue and expenditure presented to the House of Commons annually in April by the Chancellor of the Exchequer, and covering the financial year, which ends in March. The Budget contains estimates of the national expenditure and national revenue under various heads, and its introduction is made the opportunity of introducing changes in taxation. The Budget introduced in 1913 estimated an expenditure of £199,011,000 and a revenue of £194,825,000 in the financial year 1913-4. The 1921-2 Budget es-

timates were for an expenditure of £1,039,728,000 and a revenue of £1,216,650,000 (including £158,500,000 raised by the sale of surplus war stocks). Taxation per head of population in the United Kingdom amounted in 1914 to under £4, and in 1920 to about £23. The amount of money raised by local taxation is not included in this figure. Local authorities raised £84,500,000 in 1919, and considerably more in 1920, local taxation taking the form of a tax on the annual value of real property within the area concerned.

Finance in the other sense covers all dealings in 'wealth' in the form of money and in credit instruments. In a sense all production is based on 'credit', for things must be produced before they can be consumed, and their value during production is based on their anticipated value as finished articles. This theoretical conception corresponds with reality—for in many cases the actual expenses of production are borne during the period of production, not by the producer, but by other persons or institutions from which he borrows money, against the credit afforded by his personal reputation, the prospect of success of the production in question, and perhaps also the deposit of securities which can be realized in the event of his default. The business of 'finance' then consists mainly in the collection from persons or businesses which are saving money, or holding it in reserve, of funds for which they have no immediate use, and the lending of the money thus obtained to persons or businesses engaging in enterprises which are sufficiently safe for them to be able to obtain loans, but for which they have not themselves sufficient money available. In internal trade this financing of businesses is largely done by banks, which collect money from the public on 'current account', i.e. repayable on demand, and on 'deposit', i.e. repayable only after a given period or after certain notice, and lend to businesses in the form of 'loans' or 'overdrafts' so much as they deem safe in view of their obligations. In foreign trade the most frequent method of financing is through the medium of 'bills of exchange', ordering payments for goods at a future date, perhaps two, three, or six months ahead. A bill of exchange, if the names of the parties to it or some of them are satisfactory, will be discounted by a bank, or by a discounting house for the present value of the sum of money accruing when the bill falls due. The result of this operation is that the concern selling the goods can secure immediate payment, while the concern buying the goods, against which the bill is 'drawn', does not require to make any payment until the maturity of the bill, the venture being financed in the intervening period by a bank or discounting house, which

will frequently hold the bills of lading for the consignment, or other similar documents, as security. The bill of exchange has become the chief means of settling all forms of indebtedness between different countries, and the determination of the value of a bill drawn in the currency of one country in terms of another currency is dealt with under the heading *Foreign Exchanges* (q.v.). Yet another form of finance is the raising of capital for joint stock undertakings by public subscriptions, in return for which 'shares' or 'stocks' in the undertaking are given, which give a right to a certain proportion of the profits of the undertaking, together, in most cases, with a voice in its management. Various types of shares and stocks are offered to the public, e.g. debentures, preference, and ordinary. Debentures carry practically no risk, preference shares or stock a limited risk, ordinary shares most of the risk of the undertaking. Holders of debentures receive a fixed rate of interest, and have priority over preference or ordinary shareholders, as well as having a charge on the assets of the company in case of default. Preference shares rank for dividend before ordinary shares, and are also entitled to a fixed annual rate of interest. If the company is unable to pay the preference shareholders this fixed rate of interest in any year, the latter have the right to demand in succeeding years payment of arrears before anything is paid to holders of ordinary shares (except in the rare cases where the articles of association of the company otherwise specify). The surplus profits remaining after payment of interest on debentures and preference shares, if any, may then be divided amongst the ordinary shareholders to such an extent as the directors of the company deem advisable. Debentures and preference shares appeal to those investors who desire to have an assured income and a certain measure of security. Investors in ordinary shares are prepared to take more risk in the hope of obtaining a higher rate of interest on their holding.

When shares or stocks are being offered to the public for subscription, arrangements are frequently made for 'underwriting' the issue. In this way the company issuing the shares or stocks is guaranteed that the cash shall be forthcoming; for the 'underwriters', in return for a small commission, agree to take up themselves any portion of the issue not subscribed for by the public. Should the underwriters have to take up some part of the issue, they await an opportunity of disposing of it in the ordinary market.

The issues of capital as published in the *Economist* were as follows in the years named: 1906, £120,173,200; 1911, £191,759,400; 1912, £210,850,000; 1913, £196,537,000; 1920, £367,549,600. In pre-war days over four-fifths

of the total capital subscribed was for use abroad, but in 1920 home demands were so urgent that less than one-tenth went abroad.

Fin-back, or **Finner**, the name given to whales of the genus *Balenoptera*, also known as **rorquals**.

Finch, one of the *Fringillidæ*, a large family of small seed-eating perching birds, inhabiting all parts of the globe. They are distinguished by having a sharply pointed, conical, and in most cases a strongly formed bill, suitable for crushing seeds and other hard objects. The species have been divided among several sub-families, as the **haw-finches**, the **true finches**, the **buntings**, and the **bull-finches**.

Fin'den, William, line-engraver, born in 1787, died in London 1852. He engraved many illustrations for the *Annals* and other books. In conjunction with his younger brother Edward and assistants he produced several extensive series of engravings of great merit; the first and most successful of which was *Illustrations of the Life and Works of Lord Byron*. Other series followed, including the *Royal Gallery of British Art*, 1838-40, a very important publication, the engravings in which measure $13\frac{1}{2} \times 9\frac{1}{2}$ inches, and are of the highest class. The plates are executed by various engravers of the foremost rank. Besides his book-plates, Finden produced some celebrated large engravings, among which may be mentioned: *The Village Festival*, after Wilkie; *George IV*, full-length, seated on a sofa, after Sir Thomas Lawrence; *The Highlander's Return*; *The Naughty Boy*; *Deer Stalkers*; and others, after Landseer.

Fin de Siècle, a term which became popular in Paris towards the end of last century, and was also adopted in other countries. It is applied to ideas and objects which are up-to-date. Since the beginning of the twentieth century the term *vingtième siècle* is frequently used instead.

Find'horn, a Scottish salmon river which flows through the counties of Inverness, Nairn, and Elgin, and falls into the Moray Firth after a course of 62 miles.

Findlay, a city of the United States, in Ohio, midway between Tremont and Lima, 99 miles N.N.W. of Columbus. It possesses petroleum springs and natural gas, and has machine-shops, flour-mills, saw-mills, and potteries. Pop. 17,015 (1920).

Fin'don, or **Finnan**, a fishing-village, Kincardineshire, Scotland, about 5 miles south of Aberdeen, celebrated for its smoke-cured fish known as Findon or Finnan haddocks. Pop. 200.

Fine, in English law, formerly signified a sum of money paid at the entrance of a tenant into his land and on other occasions, but now generally has the signification of a pecuniary penalty

exactcd either in punishment of, or in compensation for, an offence, whether committed against an individual, in contravention of the laws of the community, or against the community itself.

Fine Arts, the arts whose object is the production of pleasure by their immediate impression on the mind, as poetry, music, painting, and sculpture. In modern usage the term is often restricted to the imitative arts which appeal to us through the eye, namely painting, sculpture, engraving, architecture, and is sometimes even restricted to the two first as more essentially imitative and imaginative.

Fin'gal, a hero of Gaelic romance, celebrated as a great warrior and a generous man in many old ballads belonging alike to Ireland and Scotland; but more especially the hero of an epic poem attributed to Fingal's son Ossian, first published by James Macpherson in 1702. See *Ossian*.

Fingal's Cave, a famous natural cavern in the Island of Staffa, one of the Western Islands of Scotland. It extends 227 feet from its mouth inward, is composed of lofty basaltic columns, beautifully jointed, and of most symmetrical, though somewhat varied forms. The height from the top of the arched roof to the mean level of the sea is 66 feet; the breadth at the entrance 42 feet, at the end of the cave 22 feet.

Finger-board, the part of a stringed instrument, as the neck of a violin, guitar, &c., to which the fingers (of the left hand) are applied in playing to stop the strings. The finger-board of a keyed instrument (played with both hands) is commonly called a *keyboard*.

Finger-prints, as a means of identification, were first called attention to in 1823 by Purkinje, the eminent physiologist of Breslau. The first practical application of the method was made in the Houghly district of Bengal by Sir William Herschel, who wrote a report recommending its general adoption in India. Sir Francis Galton subsequently took up the subject of finger-prints—or *dactylography*—as a study, and found that the innumerable ridge-patterns and characteristics noticeable on the ball of the thumb and fingers are not alike in any two persons, and persist during the whole period of human life, and that thus an accurate means of identification is afforded by simply inking the under surface of the hand and taking an impression on paper. A British Home Office committee reported in 1894 in favour of the use of the finger-print system in conjunction with M. Bertillon's anthropometric classification (as is now the practice of many foreign Governments); while identification experiments in Bengal, by means of finger-prints only, proved so successful that in

1897 the Government of India appointed a committee to examine both systems. This committee recommended the adoption of finger-prints on the Bengal plan as being superior to the anthropometric method both in simplicity of working and apparatus, and in the rapidity and certainty of its results. Since 1897 this recommendation has been gradually carried into effect throughout India, where the use of the finger-print system now extends to various branches of public business. The system is also in use throughout Great Britain, and there is a special department for finger-print records at Scotland Yard. Identification by this means, however, ought to be entrusted to experts or properly trained persons, and not put in the power of unskilled persons.—Cf. Sir W. Herschel, *Origin of Finger-printing*.

Fingers and Toes, Club-root, or Clubbing, a disease or malformation in the bulb of the



Finger and Toe Disease on Swedes

turnip, which, instead of swelling, divides, forms numerous galls or tumours, and becomes hard and useless. It is due to the attack of a parasitic slime-fungus, *Plasmodiophora Brassicae*. Diseased plants should be burnt, and infected ground should not be planted with cruciferous crops for two or three seasons. Dressing with unslaked or recently slaked lime (3 to 4 tons per acre) is said to be beneficial.

Fin'ial, in architecture, an ornamental bunch of foliage which terminates pinnacles, canopies,

pediments, &c., or any ornament of like kind. By older writers the term is used to denote not only the leafy termination, but the whole pyramidal mass.

Finiguerra (fin - i - gwer'rá), Tommaso, or Maso, a Florentine goldsmith of the fifteenth century, one of the best workers in *niello*, a form of decorative art then much in vogue in Italy. He was also the inventor of the method of taking impressions from engraved plates.

Fl'ning, a substance used to clarify liquors, usually such as are out of condition or are of inferior quality. A solution of isinglass is generally used for beer, and alum, carbonate of soda, or salt of tartar for spirits. Finings always destroy some of the real virtue of the liquor.

Finistère (fi-nis-târ; 'Land's End'), a department of France, so named from occupying its westernmost extremity; area, 2714 sq. miles. The coast-line is bold and precipitous, composed almost throughout of lofty granite cliffs, in which are numerous deep indentations, the two most important of them forming both the Bay of Douarnenez and the roadstead of Brest. The interior is traversed by hills which extend in all directions. The soil is generally fertile and well cultivated; fishing is extensively carried on; and the minerals are of considerable importance, including iron, zinc, bismuth, and lead. The manufactures consist chiefly of sail-cloth, linen, soap, oil, candles, ropes, leather, paper, and tobacco. Shipbuilding also is carried on, and the general trade is extensive. Quimper is the capital; other towns are Brest, Châteaulin, and Morlaix. Pop. 762,514.

Finisterre, Cape, the most western cape of Spain, on the coast of Galicia.

Fin'land, a republic since 6th Dec., 1917, formerly a Russian grand-duchy. It contains 125,689 sq. miles, 10·83 per cent being under lakes, and has a population of 3,320,146 (1918). The country is bounded north by Norway, east by the governments of Olonetz and Archangel, south by the Gulf of Finland, west by Sweden and the Gulf of Bothnia. The capital is Helsingfors. The country, in some parts, is hilly, being traversed by the continuations of the Scandinavian Mountains, and, in others, is sandy, marshy, and abounding in lakes, which furnish



Finial (1277), Merton College Chapel, Oxford

one of the most characteristic features of the scenery. Agriculture is the chief occupation of the people, but the chief exports are derived from the forests, consisting of timber, with wood pulp and paper. The forests occupy 60 per cent of the surface. The climate is severe, but healthy; the mean yearly temperature in the north is 27.5° F., at Helsingfors 38.7°. The principal minerals are iron and copper; granite is extensively quarried. The inhabitants are mostly Finns (q.v.) and Swedes, with a few Lapps, Russians, and Germans. Up to the twelfth century the Finns lived under their own chiefs and were pagans. Their conversion to Christianity took place about the middle of that century after their conquest by the Swedes. In 1721 the part of Finland which formed the province of Wiborg was secured to Peter the Great by treaty. The remainder was conquered from the Swedes in 1809. The religion, laws, and liberties of the country have, however, been preserved, and Finland was perhaps the freest part of the former Russian Empire. The established religion is Lutheran; but there is complete religious freedom for other bodies. There are two universities, one at Helsingfors, and the other, entirely Swedish, opened at Åbo in 1919. There are also technical and commercial high schools, and agricultural schools. The revenue and expenditure are over £50,000,000.

Finland was united to the former Russian Empire in 1809. It was proclaimed an independent and sovereign state after the revolution of 1917. The Republic of Finland, according to the Constitutional Law of 14th June, 1919, has been recognized by nearly all the Powers. The national Parliament consists of one chamber of 200 members, chosen by direct and proportional election, every Finnish citizen, man or woman, having a right to vote. The Diet lasts for three years, and the President of the republic is elected for six years. The first President of the new republic was elected in July, 1919.—**BIBLIOGRAPHY:** J. R. Fisher, *Finland and the Tsars*; L. H. S. Mechelin, *Finland in the Nineteenth Century*; A. Reade, *Finland and the Finns*; G. Renwick, *Finland To-day*; E. Young, *Finland: the Land of a Thousand Lakes*.

Finland, Gulf of, a great arm of the Baltic, 250 to 260 miles long, and from 10 to 70 miles wide, stretching from west to east between Finland on the north and Esthonia on the south. Its waters are only slightly salt. It contains numerous islands, excellent harbours, and strong fortresses.

Fin'lay, George, historian, born of Scottish parents at Faversham, Kent, 1799, died 1875. He was educated, chiefly at Glasgow, for the legal profession, but, stirred by the cause of Greek independence, he went to Greece in 1823.

and thenceforward lived chiefly at Athens, devoted to the service of his adopted country. His chief work, the *History of Greece from its Conquest by the Romans to 1864*, was published in sections under different titles: *Greece under the Romans*, *History of the Byzantine Empire*, *History of Greece under the Ottoman and Venetian Domination*, and *History of the Greek Revolution*.

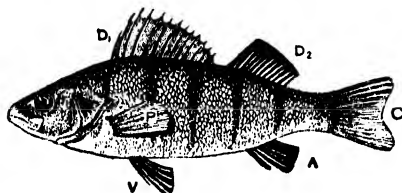
Fin'mark, a division of Norway, in the extreme north, partly bounded by the Arctic Ocean. It consists of a mountainous and usually sterile tract, stretching 140 miles north-east to south-west, with an average breadth of about 40 miles. The Lofoden Islands belong to a long line of coast where important fisheries are established. The cod-fishery employs a large number of boats and men, and a great quantity of cod-liver oil is made. The estimated population in 1920 is 45,750.

Finns, in their own language called *Suomalainen*, are a race of people inhabiting the north-west of European Russia (governments of Archangel and Olonetz), but especially Finland. In a wider sense the term Finns, with its adjective Finnish, is applied to one of the chief branches of the northern or Ural-Altaic division of the Turanian family of peoples and languages. The Ugro-Finnic family has been divided into four groups or branches: (1) the Ugrie, to which the Ostiaks, Voguls, and Magyars belong; (2) the Bulgaric or Volgaic, consisting of the Tshermishes and the Mordvins; (3) the Permian, composed of the Permiens, Sirianes, and Votiaks; and (4) the Tehudic or Baltic group. To the last belong, besides the Finns proper, the Esths of Estonia and the Lives or Livonians, the Tehudes, in the governments of Novgorod and Olonetz, and the Lapps in Archangel and the northern parts of Finland, Sweden, and Norway. The typical Finns are physically of low stature but of strong build; with round head, forehead low and arched, features flat with prominent cheekbones, and oblique eyes.

Finnish Language and Literature.—The Finnish language belongs to the Ugro-Finnic division of Turanian or Ural-Altaic family of languages, and is most nearly allied to the languages of the Esths, Lapps, Mordvins, Voguls, and Magyars. It is agreeable to the ear, rich in vowels and diphthongs, copious, and uncommonly flexible. The language is remarkably rich in declensional forms, there being as many as fifteen different cases, expressing such relations as are expressed in English by *near, to, by, on, in, with, without, along, &c.* There is no distinction of gender in nouns. The verb resembles the noun in its capability for expressing shades of meaning by corresponding inflections. Finnish literature is valuable chiefly for its rich stores of national poetry. These poems, which had been

preserved by oral tradition from the times of heathendom, were gradually dying out till 1835, when Lönnrot grouped together in one whole all the fragments he could lay his hands on and published them, under the title of *Kalevala*, as the national epic of the Finnish people. A second edition, increased almost by one-half, was published by him in 1849. He also published a collection of 592 ancient lyric poems and 50 old ballads, and collections of proverbs and riddles. A great impulse was given to the cultivation of the language in modern times. Recognized as an official language side by side with Swedish, it is becoming more and more the vehicle for imparting instruction. Works on science and history as well as poetry have been written in Finnish in recent years; a great *Finnish-Swedish Dictionary* has been published, and there are now a considerable number of newspapers. The centre of this literary life is Helsingfors. Among modern Finnish writers are: Yrjö-Koskinen, Alexis Stenwall, Erkkö, Canth, Ingman, and Pakkala.—BIBLIOGRAPHY: Eliot, *Finnish Grammar*; C. J. Billson, *Popular Poetry of the Finns*; Comparetti, *Traditional Poetry of the Finns*.

Fins, the projecting wing-like organs which enable fishes to balance themselves and assist



Fins—Perch

D₁, First dorsal. D₂, Second dorsal. P, Pectoral.
V, Ventral. A, Anal. C, Caudal.

in regulating their movements in the water. The fin consists of a thin elastic membrane supported by rays or little bony or cartilaginous ossicles. The *pectoral* or breast fins are never more than two; they are placed immediately in the rear of the gill-opening on the shoulder. In a state of rest these fins are parallel with the body, and have the apex towards the tail. The *ventrals*, pelvic, or abdominal fins, are placed under the throat or belly, and point downwards and backwards. They are smaller, in general, than the pectorals, and have sometimes long appendages. Those of the back, or the *dorsal* fins, point upwards and backwards, and vary in number from one to four, to which sometimes are added several finlets or *pinnulae*—small appendages which are seen in the mackerel. The *anal* fins are situated behind the vent, varying in number from one to three, placed

vertically, and, like the dorsal, generally deeper on the anterior margin. The *caudal*, or tail fin, terminates the body, and both propels the fish and serves as the rudder by which it steers itself. The pectoral and ventral are known as *paired* fins, and represent the fore and hind limbs of other vertebrates; the dorsal, anal, and caudal are *median, vertical, or unpaired* fins. The term 'fin' is also used for expansions connected with balancing and swimming in various other animals, e.g. whales, amphibians, cuttle-fishes, sea-snails, &c.

Finsbury, a parliamentary and municipal borough of England, forming part of London, bounded by the parliamentary boroughs of St. Pancras, Islington, Shoreditch, London City, and Westminster. From 1885 to 1918 it returned three members to Parliament, but the number has been reduced to one. Pop. 76,019.

Finsen Treatment, a surgical method introduced by a Danish doctor, Niels Ryberg Finsen (1860-1904), which consists in the treatment of certain diseases, especially those of a tubercular nature—such as lupus—by the application of the chemical rays of light in a concentrated form, the light being either that of the sun or the electric light and special apparatus being required.

Finster-Aarhorn (är'horn), the highest peak of the Bernese Alps, 14,026 feet above the level of the sea.

Fin'sterwalde (-vâl'de), a town in the province of Brandenburg, Prussia, with manufactures of cotton and woollen cloths. Pop. 10,820.

Fion, or **Fionn** (fë'on), a name given in the Ossianic poetry to a semi-mythical class of warriors of superhuman size, strength, speed, and prowess. Generally they are supposed to have been a sort of Irish militia, and to have had their name from *Fion MacCumhal* (the Fionn MacCoul of Dunbar, and Fingal of Macpherson), their most distinguished leader. Some scholars, however, believed that the Fion were of the race that inhabited Germany before the Germans, and Scotland and Ireland before the Scots.—Cf. M. Macleay, *The Literature of the Celts*.

Fiord, or **Fjord**, a geographical term (of Scandinavian origin) applied to long, narrow, and very irregularly shaped inlets of the sea, such as diversify the coast of Norway. Similar inlets of the sea are presented in the sea-lochs of the west coast of Scotland, as also in the fiords on the south-west coast of the South Island of New Zealand, where the scenery is singularly imposing. Fiords often seem to owe their origin to the action of glaciers in remote epochs of the earth's history.

Fl'orin (*Agrostis alba*), a common British grass found in pastures and waste places. It

is not of much agricultural value. A stoloniferous variety, sometimes called *A. stolonifera*, is often a troublesome weed.

Fir, a name sometimes used as co-extensive with the term *pine*, and including the whole genus *Pinus*; more properly restricted to trees of the genus *Abies*, which differ from the pines in that their leaves grow directly on the stems. The term fir, thus limited, is applied to the different varieties of the *silver fir* (*Abies pectinata*), the balm of Gilead fir (*A. balsamifera*), and the large-bracted fir (*A. nobilis*). The Scotch fir is a species of pine (*P. sylvestris*). The firs, even in the widest sense of the term, are almost all remarkable for the regularity of their growth, their tapering form, and the great altitude of their stems. Their timber is often highly valuable, being almost solely used in the construction of houses, and for the spars and masts of vessels of all kinds. Some of them are planted mainly as ornamental trees.



Fir Cone

Firbolgs, one of the legendary or fabulous tribes of the earliest period of Irish history. Some of the Irish historians begin their account of the Irish monarchy and list of kings with Slainge, the first Firbolg king, who began to reign 1934 B.C. They are said to have been driven out or subjugated by a kindred tribe from Scotland, who in turn were expelled or conquered by the Milesians. The Firbolgs may, it has been thought, correspond to the pre-Aryan inhabitants of Ireland. It has also been suggested that Firbolgs is simply the Irish name for Belgæ.

Firdu'si, or Firdau'si, Abul Kasim Mansur, the greatest epic poet of the Persians, was born at Khorassan about A.D. 931, and died there about 1020. At the request of the Sultan Mahmud, of Ghuznee, Firdusi undertook to write an epic on the history of the Persian kings, the Sultan promising him a piece of gold for each verse. Firdusi devoted a large number of years to this work, and produced an historical poem of 60,000 verses, entitled *Shāhnāma* (Book of the Kings), containing the history of the Persian rulers from the beginning of the world to the downfall of the Sassanian dynasty (A.D. 632), and consisting properly of a succession of historical epics. The

Sultan, prejudiced against Firdusi by the poet's enemies, gave him only a piece of silver for each verse. In return Firdusi retaliated with one of the bitterest and severest satires ever penned. The resentment of Mahmud compelled the poet to wander from court to court seeking a protection which the sovereigns were afraid to give. The *Shāhnāma* is one of the finest Asiatic poems. No work in the Persian language can be compared with it. It abounds in rich imagery, contains many passages of splendid poetry, and is of great interest to historians and ethnologists. A French translation of the *Shāhnāma* by Mohl, with the Persian text, was published by the French Government between 1831 and 1868. There are English translations by J. Atkinson, A. G. Warner, and A. Rogers.—Cf. E. G. Browne, *A Literary History of Persia*.

Fire and Fire-worship. According to that ancient Indian religious work, the *Mahā-bhārata*, the sacred fire, called Advuta, "is the ruler and inner soul of all creatures". In other words, it is 'the vital spark'. A Babylonian hymn, in which fire is hailed as the "great lord" and "noble son of heaven", declares: "Of all things that can be named, thou dost form the fabric". The sun and moon were in Ancient Egypt referred to as 'the fire' of the two eyes of the god Ptah. In India, where Agni, the fire-god, had solar attributes, we find the belief that the world will be destroyed by fire from the sun. Brinton has shown that in America many tribes connected fire and the sun. In several South American dialects "the word for sun is derived from that for fire, and the sun is often referred to merely as 'the great fire'". The sun was the giver of life (of the 'vital spark'); it was, as a Zunian myth puts it, "the seed-stuff of the world". The Mexican 'lord of fire' was also 'the ancient god'. Horus, the Egyptian god, was in one of his phases a god of fire and worker in metals. He was a cripple like the Greek Hephaestus, the Latin Vulcan, and the Scandinavian Loki. The association of fire with the sun and metals is brought out in ancient Indian texts referring to Agni, who has "golden teeth, a golden beard, a golden form, tawny hair, red horses, and a golden car". The Egyptian Ptah, the Memphis god of artisans, has a beard tipped with gold. There was likewise a 'golden Horus'. In an Indian text a gold diadem has "the complexion of fire", and in another it is stated that "gold was born the offspring of Agni". The 'Golden Hathor' of Egypt was a sky-goddess with solar and lunar attributes like the 'Golden Demeter' of Greece. Farnell, discussing the practice of women carrying torches over the land, in connection with Demeter worship, says they are "figures of a world-wide agricultural ritual, intended to invoke the fructifying warmth of

the earth". Blood was shed on such occasions. Fire-gods were in many lands, as in India, connected with the gods of lightning and thunder who sent rain. Fire was supposed to come from water, and in India the five rivers of the Punjab "are", says the *Mahá-bhárata*, "said to be the mothers of the fires". The sun, in Egyptian and other mythologies, rises at the beginning from the primeval deep. Babylonian temples had a 'house of light' and a 'house of washing', and the fire-god was Girru, Gibil, or Nusku. Jastrow has emphasized that the Babylonian incantation ritual revolved round two ideas, 'water and fire'. In Gaelic lore the butterfly is a form of the fire-god. It is called 'teine-de' (fire of god) and 'dealan-de' ('de' is 'god'). The latter term is applied also to the brightness of the nocturnal heaven, to lightning, to coal, and to a burning stick which is whirled round as it is being carried from a 'new fire' lit at the Beltane or some other festival. In Ancient Britain household fires were extinguished once a year, and 'new fires' were kindled ceremoniously with 'fire sticks'. The 'new fire' was 'fire from heaven' and was regarded as being identical with lightning and the sun. The tree was supposed, like the butterfly (a form sometimes assumed by souls), to contain fire, and was connected with the sky deities. In Gaelic the word for a sacred grove is derived from the same root (*nem*) as the word for the sky. The ceremony of creating 'new fire' was world-wide. Old world and new world fire ceremonies were of similar character. Holy fire was kept burning in sacred places by many peoples. In Mexico as in Rome it was watched by vestal virgins. There are also widespread myths of heroes or gods who, like Prometheus, brought fire from heaven. Purification fire ceremonies were widespread. The Persians regarded fire as being particularly sacred. The custom of cremating the dead was connected with the belief that souls were transported by means of fire to Paradise. In India the god Agni conducts souls to Paradise. An *Iliad* reference to cremation is of importance in this connection. Achilles sees in a dream the ghost of his dead friend Patroclus, who declares that he will never return from Hades after he has received his 'due' or 'meed' of fire.

Fire-alarm, an apparatus, mechanical, electric, and telegraphic, used for detecting fires, and for giving instantaneous notice of an outbreak. Detectors are often placed in the different apartments of a building; they ring an alarm when the temperature reaches a certain height. In large towns a series of signal-boxes is distributed in different quarters from which an alarm can be immediately telegraphed to the fire-brigade station.

Fire-arms Act, 1920, prohibits any person

under 14 years of age, and any other person to whom a police certificate (known as a 'fire-arm certificate') has not been granted, from purchasing, possessing, using, or carrying any fire-arm or ammunition. Persons, however, in the naval, military, or air service, or in the police force, gunsmiths, dealers, carriers, warehousemen, officers of the post office, members of approved rifle-clubs or cadet corps, persons engaged in the humane slaughter of animals for food or other purposes, and persons possessing fire-arms or ammunition as part of the equipment of a ship or carrying such for the use, for sporting purposes, of a certificated person, are exempt from the obligation to hold certificates in respect of fire-arms or ammunition carried, used, or possessed in the course of duty or business. Persons manufacturing, selling, hiring, repairing, testing, or proving, or lending or transferring fire-arms or ammunition, must be registered as fire-arms dealers. The registration fee is £1. Any constable may demand production of a certificate. The fee payable for a certificate is 5s.; it continues in force for three years, and is renewable for the like period from time to time at a cost of 2s. 6d. Antique fire-arms possessed as curios or ornaments are excluded from the Act, and a certificate may be dispensed with in respect of fire-arms possessed only as trophies of the war. See *Gun Licence*.

Fire-ball, (1) an obsolete kind of offensive weapon, consisting of a ball filled with powder or other combustibles, intended to be thrown among enemies, and to injure by explosion, or to set fire to their works; (2) a name applied to meteors of special brilliancy. These in general differ from others only by being of greater mass and volume. They therefore give out a larger amount of light when heated to incandescence, and are able to penetrate the atmosphere to a greater depth and descend nearer to the earth's surface before becoming disintegrated. Not infrequently the luminous trails formed by the particles brushed off the surface of the meteor continue visible for many minutes after their appearance, and assume twisted forms through the diverse wind currents existing at different heights.

Fire-bars, bars of iron fitted into the bottoms of furnaces to support the fire. Their shape and size depend very largely on the nature of the furnace. Fire-bars are not used in the furnaces of large land boilers. The grate consists of hundreds of links which are fastened together to form an endless iron belt about 7 feet wide, which is carried over two rollers, one at the back end of the grate, and one at the forward end. This endless belt of links is kept slowly moving, and carries new fuel into the fire and ejects the spent ash at the back.—**BIBLIOGRAPHY**: W. Inchley, *Steam Boilers and Acces-*

series; *Modern Mechanical Engineering* (Gresham Publishing Co.).

Fire-bote, in old law, an allowance of fuel to which a tenant was entitled, from the estate on which he resided.

	1	2	3	4	5	6	7	8
Silica	55.61	56.42	58.00	62.35	44.37	65.10	48.04	48.09
Alumina	27.50	26.35	30.85	18.47	38.59	22.22	34.47	32.11
Oxide of iron	1.91	1.33	1.55	4.77	1.82	1.07	3.05	2.34
Lime .. .. .	.32	.60	.80	trace	.51	.14	.66	.43
Magnesia .. .. .	.79	.55	—	1.36	.30	.18	.45	.22
Potash .. .. .	.81	.48	—	2.47	—	.18	1.94	3.31
Soda	—	—	—	—	—	—	—	—
Titanic acid .. .. .	.33	1.15	—	1.10	—	—	—	—
Organic matter or loss in calcinate .. .. .	.34	—	—	—	—	.58	—	—
Combined water	9.96	10.95	9.70	5.22	11.78	7.10	11.15	9.63
Moisture	2.12	2.80	—	4.15	2.69	2.18	—	2.33

Fire-box, the structure of a boiler formed to contain the fire. It is usually constructed of steel, lined with refractory brickwork; but in locomotive practice it is generally made of copper, lined with fire-bricks.

Fire-bricks, bricks used in furnace construction or for other purposes where a high temperature is used. The qualities required in good fire-bricks are as follows. "They should not melt or soften in a sensible degree by exposure to intense heat long and uninterruptedly continued. They should resist sudden and great extremes of temperature. They should support considerable pressure at high temperatures without crumbling. They may be required to withstand as far as practicable the corrosive action of slags rich in protoxide of iron or other metallic oxides." (T. Percy, *Fuel*, p. 144.) These qualities are not all shown in the highest degree by any one brick. In selecting a brick, therefore, attention must always be given to the special conditions in which it is to be used, for one which would be good under one set of conditions may prove very bad under another. —Cf. A. H. Sexton and W. B. Davidson, *Fuel and Refractory Materials*.

Fire-brigades are bodies of men organized in towns to work the fire-engines and other means of saving life and property from fire. They are generally under the control of the municipal authorities, and are mainly supported by the rates. The London fire-brigade, established in 1866, numbers about 1355 officers and men, and has a grant from Government of £10,000.

Fire-clay is the name given to the clay used in the manufacture of bricks intended to withstand high temperatures. Fire-clays usually need temperatures exceeding 1500° C. to fuse them, and it is essential that they shall contain no matter which is likely to promote the forma-

tion of fusible silicates. Some characteristic analyses of fire-clays are given in the following table. The table for eight specimens is taken from Sexton and Davidson's *Fuel and Refractory Materials*.

Fire-damp is the miners' name for methane, CH₄. It is sometimes abundantly evolved in coal-mines, and may be productive of the most dreadful results when it explodes, by causing the death of men at work in the mine. When it constitutes more than $\frac{1}{13}$ th of the volume of the atmosphere of mines, the whole—with the fine coal-dust added—becomes highly explosive. The safety-lamp affords the chief protection against this danger. See *Damps*.

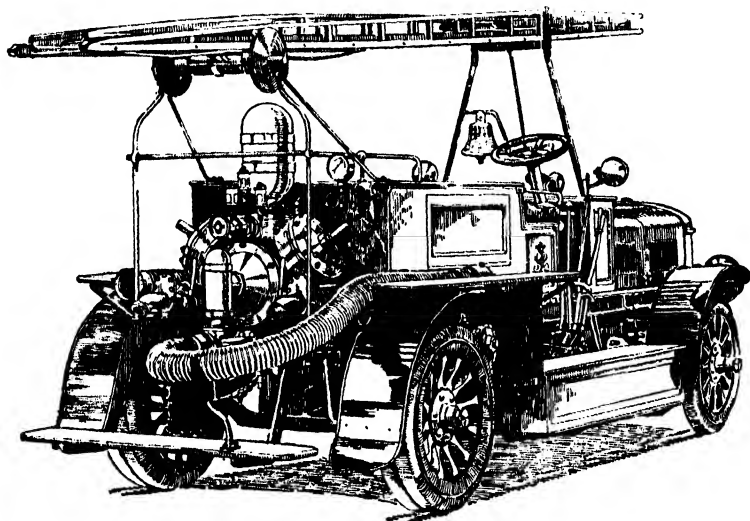
Fire-engine, an engine for throwing water to extinguish fires and save buildings. Fire-engines are a species of force-pumps, in which the water is subjected to pressure sufficient to raise it to the required height in the form of a jet. The pump draws its water through a flexible suction-pipe, which is placed either in a portable cistern kept supplied by buckets or hose, or in a river, canal, or pond, or other source of supply. In large towns the suction-pipe is sometimes connected to one or more street hydrants, the engine thus being used to increase the pressure already existing in the water-main.

For many years the manual fire-engine was the only type in use. Then followed the steam fire-engine, which came into prominence during the latter half of the nineteenth century. The average output of a horse-drawn British steam fire-engine is 300 gallons per minute, but engines of much greater capacity have been made, the largest being one supplied to Liverpool in 1893. It is able to deliver 1800 gallons a minute.

Whilst both manual and steam fire-engines are still extensively used, the latest types of fire-engines are motor propelled. Both steam and petrol motor fire-engines are made, the latter being in more general use. Such engines can start instantly and travel at speeds up to 40 miles an hour, so that their advantages over the horse-drawn machines are obvious. The illustration shows a modern petrol-driven 'Hatfield'

motor fire-engine as supplied to H.M. King George V by Merryweather & Sons, of London, who were the pioneers of motor fire-appliances. The fire-pump on this machine is of the treble-barrel reciprocating type, driven by a single crank; several sizes are made, ranging from 150 to 600 gallons capacity per minute, with motors of from 30 to 70 horse-power. The petrol-motor, in addition to propelling the vehicle along the road, drives the pump through silent chain gearing. Accommodation is provided for hose and usual fire-brigade gear, and the chassis is often arranged to carry a detachable fire-escape

in the horizontal position. Various sizes are made, the usual heights of extension ranging from 30 feet to 60 feet, though escapes to extend even to 100 feet have been constructed. The very latest development in fire-escape construction is found in the Merryweather motor turntable ladders. In these machines the power of the motor which propels the vehicle is ingeniously utilized to operate the telescopic ladders, which are permanently mounted on a motor chassis, and which, by means of patented mechanism, can be raised from the horizontal to the upright position, and also extended to their full height



Motor Fire-engine

or light ladders. Frequently a chemical engine for dealing with small fires is fitted also, and in this way a complete fire-extinguishing and fire-escape equipment is provided on one vehicle.

Fire-escape, a contrivance for enabling persons to escape from the upper part of a building on fire. There are several kinds, the most popular form for private use being the 'chute', which consists of a tube of canvas fastened to an iron frame in the window opening. The end of the escape is thrown out of the window and held at the bottom, when persons can make their escape very rapidly by sliding down the interior of the chute.

The escapes used by fire-brigades usually consist of an arrangement of long ladders worked on the telescopic principle and extended by means of winding gear. They are mounted on wheels for easier transport from place to place, and, unlike earlier types, modern hand-drawn escapes are designed to travel with the ladders

of 90 feet with no effort on the part of the driver, who merely touches a small lever.

Firefly, a name popularly given to any winged insect which gives out light. Except the lantern-fly, the fireflies are all beetles, and are members of two nearly allied families, the Elateridæ or skipjacks, and Lampyridæ, to which the glow-worm belongs. The British glow-worm has too little luminosity to entitle it to the name of firefly, but the *Lampyris italica* and *L. corusca* of Canada are allied to it. True fireflies are found only in the warmer regions of the earth. The *Elater* or *Pyrophorus noctilucus* of South America and the West Indies is one of the most brilliant, giving out its light from two eye-like tubercles on the thorax. Their light is so powerful that small print may be read by it, and in Hayti they are used to give light for domestic purposes, eight or ten confined in a phial emitting sufficient light to enable a person to write.

Firelock, a musket or other gun, with a lock furnished with a flint and steel, by means of which fire was produced in order to discharge it; distinguished from the older matchlock, which was fired with a match.

Fire of London, The Great, broke out in a house near London Bridge 2nd Sept., 1666, and raged for several days. Two-thirds of London was destroyed—89 churches and more than 13,000 dwelling-houses. The monument erected by Wren at Fish Street Hill commemorates the Great Fire, and at one time bore an inscription attributing the fire to the Popish faction.

Fire-places. Fire-places are usually constructed in the walls of a room, and where possible should be placed in an inside wall, so as to economize the heat which passes through the back of the fire-place. For ordinary register stoves the depth of the opening should be 1 foot 2 inches. For dog grates 1 foot 6 inches is better. The height of the opening for ordinary stoves is 3 feet, and it is usually finished with an arch turned on an iron bar or bars if the breast projects more than $4\frac{1}{2}$ inches from the face of the wall, and the jamb on either side is of less width than $17\frac{1}{2}$ inches; the bars must be turned up and down at the ends, and be built in the jambs for at least $8\frac{1}{2}$ inches. The back of a fire-place set in a party or internal wall must be $8\frac{1}{2}$ to 12 inches thick above the mantel-piece. When the wall is external, the thickness may be $4\frac{1}{2}$ inches. The breast of every chimney and the brickwork surrounding every flue should be $4\frac{1}{2}$ inches thick. Fire-places for kitchen ranges require a depth of 1 foot 10 inches at least, and a height of 5 feet. The hearthstone should be 6 inches longer than the opening on each side, and 18 inches wide in front of the breast of the fire-place. On every floor except the lowest the hearthstone must be laid on brick trimmer arch or other incombustible material, and be solid for a depth of at least 6 inches. On the lowest story the hearthstone may be bedded on concrete covering the site, or on solid material placed on the concrete. The centering on which trimmer arches are turned is often left in order that the ceiling laths may be nailed to it. Unless this possibility is borne in mind, less than 6 inches clear depth may be left for the hearthstone. This difficulty does not occur when the trimmer arches are turned on cast-iron centres. Fire-places are allowed to be built on corbels of brick, stone, or other incombustible material if the work so corbelled out does not project from the wall more than the thickness of the wall measured immediately below the corbels, but all other fire-places must be built on solid foundations and with footings similar to the wall against which they are built. Under the Chimney Sweepers Act the statutory size of

flues to fire-places was 14 by 9 inches, but this is not now enforced. In order to economize in cost and space when gas-fires are to be installed small flues made of terra-cotta can be built in the thickness of a 4-inch partition without projecting beyond the face. It is usual to have one fire-place with a 9-inch by 9-inch flue for cooking, &c., when these flues are used. In hospital wards fire-places are placed in the centre of the wards with descending flues carried in the floors to the outside walls.

Fire-proofing, the rendering of materials or structures non-inflammable and heat-resisting. Fire-proofing is carried out in a great variety of ways. Buildings are rendered fire-proof largely by the use of the maximum amount of steel, brick, and concrete, and the minimum amount of wood and inflammable material. Wood can be rendered less inflammable than it naturally is by painting it with fire-proof paint, which is paint mixed with asbestos. Ordinary safes and strong-rooms are made heat-resisting by having very thick sides and doors which are filled with salts containing water, e.g. borax.

Fire-raising, in Scots law, is the same as arson in English law. In Scotland it is a capital crime in some cases, but capital punishment is not now inflicted. See *Arson*.

Fire-ships, in naval warfare, vessels filled with combustibles, and fitted with grappling-irons, to hook enemies' ships and set them on fire. This ancient device once was frequently used in warfare, but since the introduction of iron instead of wood in shipbuilding, and the enormously increased range of naval guns, a fire-ship is as obsolete as a cross-bow or a javelin is in land-fighting.

Fire Tactics. The Field-Service Regulations of the British army definitely state that "the foundation of infantry tactics is the combination of fire and movement", while the accepted definition of the word tactics is "the art of manœuvring troops in the presence of the enemy". The expression 'fire tactics' may therefore be taken to mean "the art of applying fire to a selected target in the manner and volume most conducive to assisting the movement of other troops".

The days are long past when movement and fire were two separate parts of a soldier's training; when fire could only be delivered at point-blank ranges, and then merely as an item in a battle; when troops could be enjoined to "wait until you see the whites of their eyes" before firing; and when they could manœuvre in perfect safety, as far as damage from fire was concerned, in full view of an opposing force. In modern days the position is entirely different. The excellence of the present-day guns and small-arms makes battle-field manœuvring impossible,

and increases immensely the area in which a modern battle takes place. Then fire was used *after* troops had got to close quarters; now it is used to enable the same troops to reach that position. Then a battalion might move and fire by the executive command of its leader; now the commander explains his scheme, gives his orders, and the work is carried out by subordinates who control a system of small and easily handled fire-units working in close co-operation with other similar units, and able to move, either in advance or retirement, under any available cover, and with the support of the fire of other units or arms.

This word 'support' is the guiding principle in modern fire tactics. Against modern arms, be they guns, machine-guns, or rifles, no unit, however small or however efficient, can hope to succeed by its own unaided efforts, when these efforts take the form of a direct and unsupported advance of the entire unit. To take an extreme example. Six men in a small trench are being attacked by a similar number across broken ground. However expert in the use of the rifle the attackers may be, they will surely fail in their attack if all the six fire together and then immediately advance in the same manner. This will be equivalent to using the power of fire and movement separately, and the time occupied in advancing will afford the defenders in their trench an opportunity of firing in safety and with comparative accuracy at the advancing men. Should the attackers, on the other hand, arrange for certain of their number to keep up an aimed fire on the enemy trench while the remainder make ground, they will be using fire to assist movement, and will be affording the enemy no opportunity of returning the fire in safety.

This example illustrates in a very elementary way the essential principle of co-operation and covering-fire. In the modern organization of battalions arrangements exist which provide the means of applying this necessary covering-fire to a much greater extent than was formerly thought necessary or possible. Thus a platoon has in its own organization, as a means of providing its own covering-fire, two sections provided with Lewis guns, the functions of these sections being very largely to throw a stream of bullets on to the point of the enemy's line which for the moment is of the most tactical importance, thus enabling the rifle sections to make ground without undue casualties.

Fire-works may be divided into three kinds, the classification depending chiefly on the method of setting them off or firing them. Some are fired whilst held in the hand, or set off on the ground; others, such as rockets, are projected by the aid of a small explosive carried within

themselves, and explode in the air. Others, heavier and more showy, such as shells, are projected from a small grenade or mortar, similar to a trench mortar. Lastly there are what is known as 'set-pieces' or fire-work pictures, which comprise fire-works representing waterfalls, portraits, mottoes, crests, aeroplanes, or any special design desired.

Amongst fire-works of the first kind may be mentioned rockets, wheels or whirligigs, and Bengal lights. Rockets are charged on what is known as the spindle system, a long steel needle penetrating the paper tube that holds the charge. After the tube has been filled, and the spindle withdrawn, a cavity remains, which after the explosion becomes filled with the expanded air, causing the ascent of the rocket. The composition contained in the upper part of the paper tube is so arranged as to make it burst at the proper altitude, and scatter the stars with which it is filled.

Shells are made of a kind of *papier mâché* consisting of layers of paper and calico compressed into the shape of a bowl until they are as hard as iron. Two of these bowls are filled with large stars and joined together, then covered with canvas. They are fired from a small mortar, and the expelling explosion ignites a fuse connected with a time-fuse inside the shell, causing the shell to burst and ignite the stars.

The following are some of the ingredients used: oxalate of soda, regulus antimony, nitrate of lead, picrate of ammonia, subchloride of copper and carbonate of strontia. Methylated spirits are frequently used in mixing colours. Iron filings make wonderful coruscations, and are used to represent falls and cascades. Steel filings are also used with even better effect.

With set-pieces any design can be produced in outline. The subject is first set out on squared paper, and sealed, and it is then transferred to a frame, which is divided into small squares. The design is traced with small bamboo canes, which bend easily, and can be made to follow the design. Small fire-works on the rocket principle are fastened to the frame-work; these are called lances and gerbs. A lance is a small paper tube filled with a composition and priming on top; this is used for small devices, such as crests, mottoes, &c. A gerb is much larger, and filled in certain proportions with a composition of sulphur, saltpetre, and charcoal, a colouring mixture being added. This is used for large productions. Part of the manufacture of gerbs is called coning. Cones are attached to them containing salts of various metals, sodium giving a yellow light, calcium a red, strontium a crimson, and barium a green, and these produce the colour effect on the set-piece. The lances and gerbs are glued perpendicularly to the canes

which trace the outline desired. They are then attached to a fuse, which is a piece of cotton soaked in a liquid composition, dried, and enclosed in a paper tube. When a port-fire is applied to the end of this fuse or quick-match, the ignition is instantaneous over the whole set-piece.

Magnesium powder and lycopodium are used for giving lightning effects in stage pieces. Life-saving rockets carry a line from the shore to a wrecked ship, or from ship to shore. Fire-works are much used for signalling purposes. Rockets and ground-flares played a big part in the European War, and were used as signals everywhere. The S.O.S. was usually a combination of coloured rockets, commonly known as Very lights, which were fired from a specially made pistol.

Firkin, a British measure of capacity, now legally abolished, the fourth part of a barrel or half of a kilderkin. The measure varied with the material. For beer it was equivalent to 9 imperial gallons.

Firm, a partnership or association of two or more persons for carrying on a business; a commercial house; or the name or title under which a company transacts business.—*Long Firm*, a term given to that class of swindlers who obtain goods by pretending to be in business in a certain place, and ordering goods to be sent to them, generally from persons at a distance, without any intention of payment. When they have obtained all they can in this way, they decamp, to reappear elsewhere under a different name. A person practising this system is said to be a member of the Long Firm.

Fir'mament, the vault of heaven, originally conceived as a solid canopy. The Hebrew word *raki'a*, which is so rendered in Scripture, conveys the idea of expansion and solidity, since the root signification of the word is that which is expanded by beating out. The English *firmament* is adopted from the Latin *firmamentum*, which in the *Vulgate* is the equivalent of the Greek *stereōma* (*stereos*, firm, solid), by which the writers of the *Septuagint* rendered *raki'a*.

Fir'man (Pers. *fermān*), a decree, order, or grant of an Oriental sovereign, as of Turkey, issued for various special purposes, for instance to ensure a traveller protection and assistance. It differs from a *Hatti Sherif* in so far as it may be signed by any minister, whereas the *Hatti Sherif* is approved by the Sultan himself with his special mark, and is therefore supposed to be irrevocable.

Firozābād', a town and municipality in Agra district, in the United Provinces of India, headquarters of a tahsil of the same name, 24 miles E. of Agra. It contains numerous ruins of handsome buildings, and is a station on the E. Indian

Railway, 817 miles from Calcutta. Pop. 16,000. Pop. of tahsil or revenue district, 108,521.

Firozpur', a commercial town, Punjab, India, capital of a district of the same name. The arsenal is the largest in the Punjab. Pop., including the military cantonments, 2 miles S. of the city, 50,000. The district forms the south-western portion of the Jalandhar division. Area, 4302 sq. miles; pop. 958,000.—*Firozpur* is also the name of a town in Gurgion district, Punjab. Pop. 6920.

Firozshah', a battlefield in Firozpur district, Punjab; the scene of the defeat of the strongly entrenched Sikh army by the British forces under Sir Hugh Gough and Sir Henry Hardinge, 21st Dec., 1845.

First-aid to the Sick and Injured. The term First-aid is the expression used to denote the temporary treatment of persons suffering from sudden illness or the effects of accident, pending their being placed under medical care. Its objects are two-fold; first, as far as possible to alleviate suffering; second, to prevent the aggravation of the injury or illness by injudicious handling. When a person is seen to fall or to be knocked down in the streets, the first impulse of well-disposed but ignorant onlookers usually is to raise the patient and even to endeavour to place him on his feet. Such a procedure may be attended with very serious consequences to the sufferer. It may be necessary at times, as in the case of a street accident, to remove the injured person out of the way of traffic, but this should be done with the greatest care, as any rough or careless handling may seriously aggravate the injury. As a general rule the person with a knowledge of first-aid will endeavour to ascertain the nature of the injury or illness and to apply the necessary treatment before moving the patient. The treatment, if intelligently applied, will, in the case of many injuries, do much to lessen the suffering of the injured person.

It has been said by a great surgical authority that the first twenty minutes after an accident are the most important. That is to say, given the skilful application of first-aid within a brief period of the occurrence of an accident, the chances of untoward complications are appreciably diminished and, in serious cases, the prospects of complete recovery materially enhanced. Cases not infrequently happen in which the lapse of a much less period than twenty minutes before the application of first-aid would entail fatal consequences. The most common of these are hæmorrhage or bleeding, poisoning, and suspended animation caused by immersion in water, exposure to noxious gases, or electrical shock. Many instances could be given in which life has been saved by the prompt

application of first-aid in such cases and, conversely, many could be quoted in which life has been unnecessarily sacrificed while untrained onlookers have, perforce, allowed the vital moments to pass.

Much has been done by legislative enactment and other means to provide safeguards against the risk of accidents, but no legislation can put a stop to human carelessness or human recklessness, and it is safe to say that in every industrial country the yearly casualties attendant on civil life, resulting in death or more or less serious injury, are approximate to the losses entailed by a considerable war.

Accidents being inevitable, it is the intention of this article to show, as briefly as may be, the steps, apart from surgical or medical treatment, that have been taken in this country to mitigate their consequences by bringing within the reach of all the opportunity of acquiring a knowledge of first-aid.

The course of training in first-aid as laid down by the St. John and the St. Andrew's Ambulance Associations, and followed by the bodies which have, in more recent times, taken up this branch of education, embraces instruction in elementary anatomy and physiology, the symptoms and practical treatment of cases of sudden illness such as fits, fainting, and apoplexy, and of all cases of accident embracing fractures, wounds, and hæmorrhage, burns and scalds, choking, shock, and minor injuries, as well as the symptoms of and antidotes to poisons accidentally or deliberately administered, and, lastly, the methods to be adopted for the transport of the injured. It will thus be seen that the knowledge to be acquired is of a useful character, quite apart from its practical application, for everyone is the better of having at least an elementary acquaintance with that wonderful thing, the structure of the body. It must be here emphasized that first-aid must necessarily be merely a temporary and palliative measure. If it were generally to be supposed that first-aid treatment were more than a temporary safeguard pending the earliest possible surgical or medical attention, it would be better never to teach it. It is true that there are cases of minor illness or accident which scarcely necessitate medical attention, but in ninety-nine cases out of a hundred the first-aid must remember that his duty, first-aid having been performed, is to get his patient to hospital or under the care of a doctor with all the speed he may.

Systematic instruction in the theory and practice of first-aid was established in England by the St. John Ambulance Association in the year 1877, and was extended to Scotland in the year 1879. Scotsmen, however, have a liking for national institutions, and, chiefly on the

initiative of medical men and employers of labour in Scotland, the St. Andrew's Ambulance Association was formed in 1882. At that time St. John did not see its way to withdraw from work in Scotland, while it is on record that St. Andrew's made sporadic incursions into the northern parts of England. No doubt this friendly rivalry in a good cause had a stimulating effect in the earlier stages of the movement, but its usefulness diminished, and the danger of overlapping increased, with the firm establishment of the ambulance cause. In the year 1908, therefore, both bodies agreed that, for the future, the border between England and Scotland should, so far as Great Britain was concerned, form the demarcation line of their respective spheres of work.

The classes of instruction promoted by both associations at once received enthusiastic support, chiefly, it must be said, on the part of workmen engaged in occupations attended with danger. Railwaymen, miners, shipyard and factory workers were eager to be taught and found a ready help from the members of the medical profession, who cheerfully devoted as many hours as they could spare to the work of instruction. A remarkable feature of this movement is that it does not grow stale. Year by year many thousands are instructed, yet year by year thousands more come forward for instruction.

No review of the ambulance movement would be complete which omitted to refer to the St. John Ambulance Brigade and the St. Andrew's Ambulance Corps. These organizations are disciplined bodies formed for the double purpose of enabling holders of first-aid certificates to perfect themselves by continued practice, and of providing organized assistance for public functions at which accidents are likely to occur. For this purpose they are divided into units of convenient size formed primarily for civilian purposes. These organizations played no small part in the provision of personnel both in the South African War and in the European War of 1914-8.

Within recent years the work of instruction in first-aid has been undertaken by several organizations other than those already named. Although it scarcely falls within the sphere of civilian ambulance, mention must be made of the British Red Cross Society, incorporated by Royal Charter, which was formed in 1905. Its operations are carried out throughout the whole country with much success. Its principal object is to train and maintain a body for the purpose of acting as an auxiliary to the medical services of the navy and army in time of war, and the usefulness of its work was shown during the European War of 1914-8. It is in connection

with this society that the organization popularly known as the V.A.D.'s was raised and maintained.

The St. Patrick Ambulance Association was instituted in Ireland in 1912 with head-quarters in Dublin. This association carries on work in Ireland on lines similar to those of the sister associations in England and Scotland.

Educational authorities and organizations such as the Boys' Brigade, Boy Scouts, Girls' Guildry, and Girl Guides promote classes of instruction in first-aid, but these, as a rule, do so in conjunction with either the St. John or St. Andrew's Ambulance Association.

In all other parts of the world there are numerous associations carrying on teaching and training in first-aid.

First-aid has also received the approval of the Government. The Marine Department of the Board of Trade requires candidates for the certificate of master or mate to hold a recognized first-aid qualification. Mine managers are also required to have a similar qualification. Regulations have also been laid down whereby mines rescue stations, with ambulance personnel, have been established. Other regulations make compulsory the provision of ambulance rooms in certain classes of factories. It is but due, however, to employers of labour to say that such provision had, in many cases, been made long before the introduction of Government regulations.

The staffs in the railways, fire brigades, tramways, police forces, &c., throughout the kingdom, although not compelled to undergo a first-aid training, voluntarily and willingly take up this work and are without a doubt amongst the most efficient first-aiders in the country. Railwaymen, who were the first to support the first-aid movement, have maintained their position in the forefront, and there is no body of workmen in the course of whose calling a knowledge of first-aid is so much required. The expense of the training of the employees in most of these companies or corporations is borne by the company or corporation by which they are employed.

A passing reference must be made to the ambulance wagon, that necessary link between the patient and the doctor. In England the ambulance wagon service is usually run by the municipal or county authority. In Scotland the St. Andrew's Ambulance Association maintains motor ambulance wagon services ready at all times to deal with cases of accident or sudden illness, and in the principal towns these wagons are manned by permanent ambulance attendants fully qualified to render first-aid. The original horse-wagons of last century have long since disappeared. Motor traction for ambulance

purposes was tried by the association by way of experiment in the year 1906, and at the present time the association has a fleet of nearly one hundred motor ambulance wagons covering the whole of Scotland. That country is particularly well provided for in this respect, for, in addition to the association's vehicles, wagons have been provided by a few of the municipalities and numbers of the coal-mines are in possession of this necessary means of transport. It is but due to the Scottish branch of the British Red Cross Society to say that the coal-mine wagons and a very large augmentation of the fleet of the St. Andrew's Ambulance Association formed its generous gift to civilian ambulance at the close of the European War.

First-fruits, in the Church of England, the income of every spiritual benefice for the first year, paid originally to the Crown, but now to a board, which applies the money so obtained to the supplementing of the incomes of small benefices. See *Annates*.

First Offenders. At common law magistrates had power, in lieu of passing sentence upon first offenders, to bind them over in good behaviour for a period, but the infrequent use of the power led to the legislature giving it a statutory sanction in all courts of criminal jurisdiction by the passing of the First Offenders Act, 1887, while in 1907 the Probation of Offenders Act extended the power to all offenders whether first offenders or not. The latter Act repeals the former. It empowers the court, in view of the character, antecedents, age, health, or mental condition of an accused person, or of the triviality of the offence, or of the extenuating circumstances under which the offence was committed, and of the inexpediency of inflicting punishment, (a) in the case of an offence chargeable before a court of summary jurisdiction, not to proceed to conviction, but either to dismiss the charge or to discharge the accused on his being bound over to be of good behaviour and to appear for conviction and sentence if called upon within such time (not exceeding three years) as the court may appoint; and (b) in the case of a conviction on indictment of an offence punishable with imprisonment, not to proceed to sentence, but to bind the accused to be of good behaviour and to appear for sentence if called upon within such period (not exceeding three years) as the court may specify. The court may in its discretion lay down further conditions providing for supervision over (a) the associates and haunts of the offender; (b) where the offence is drunkenness or one committed under the influence of drink, the power of the offender to procure intoxicating liquor; and (c) the employment of the offender. For the period specified the offender may be

placed under the supervision of a 'probation officer', who is named in the order by the court, and whose duties, subject to the direction of the court, are (a) to visit the offender at intervals and to report; (b) to see to the observance of the conditions laid down by the court; (c) to advise, assist, and befriend the offender; and (d) if necessary to find him suitable employment. Provision is made for dealing with offenders who fail to observe the conditions of their release.

By the Children Act, 1908, restraints are placed upon the punishment of children and young persons. A child (i.e. under 14 years) may not be sentenced to imprisonment or penal servitude; a young person (i.e. between 14 and 16 years) may not be sentenced to penal servitude, nor even to imprisonment unless too unruly or too depraved to be sent to a place of detention. No person under 16 years of age may suffer the death penalty. In addition to the methods of dealing with offenders under the Probation of Offenders Act, a youthful offender may be (a) committed to the care of a relative or other fit person; (b) sent to an industrial or reformatory school; (c) whipped; (d) ordered to pay a fine; or (e) committed to a place of detention, or his guardian may be fined or ordered to give security for his good behaviour.

Firth, or Frith, an estuary, a term applied in Scotland to arms of the sea, such as the Firth of Clyde, of Tay, and of Forth, &c. It is the same word as the Norwegian *fjord*.

Fischart (fish'ärt), Johann, German satirist, born between 1545 and 1550, died in 1589. His writings are mostly satirical, partly in prose, partly in verse, partly of both mixed together, and have the most whimsical titles. As a satirist he is the most unrestrained of his age, the Papal dignity, and the lives of the priesthood and Jesuits, astrological superstition, scholastic pedantry, &c., being among his favourite subjects of attack. His most celebrated works are a rifacimento of the *Gargantua* of Rabelais, *Das glückhafte Schiff von Zürich* (The Lucky Ship of Zurich, 1570), and about fifty others.

Fischer, Ernst Kuno Berthold, German philosopher, born at Sandewalde, Silesia, 23rd July, 1824, died in 1907. Educated at the Universities of Leipzig and Halle, where he studied philosophy, philology, and theology, he was tutor at Heidelberg University, but was compelled to discontinue his lectures on account of his advanced views. He was then professor of philosophy at Jena from 1856 to 1872, when he succeeded Zeller at Heidelberg. Fischer belonged to the modified Hegelian school, and greatly popularized Kant's philosophy. His works include: *Diotima: the Idea of the Beautiful* (1849); *Logic and Metaphysic, or the Doctrine of Science* (1852); *Francis Bacon and his*

Successors (1856); *The Life and Character of Benedict Spinoza* (1865); *Anti-Trendelenburg* (1870); *Goethe-Schriften* (1895-1904). His most important work, however, is his *History of Modern Philosophy* (1852-94; new edition, 1897-1903). This monumental work is written in the form of monographs on Descartes, Leibnitz, Kant, and other great philosophers down to Schopenhauer.

Fisher, Rt. Hon. Herbert Albert Laurens, British historian and politician, born in London in 1865. Educated at Winchester and New College, Oxford, Paris, and Göttingen, he became tutor and lecturer in history at Oxford. In 1912 he was appointed vice-chancellor of the University of Sheffield, retaining his post until 1916, when he became President of the Board of Education. He entered Parliament for Sheffield in 1916, and in 1918 was returned for the English universities. As Minister of Education Fisher was responsible for the Education Act of 1918. He was elected a fellow of the British Academy in 1907, and delivered the Lowell lectures at Boston in 1909. His works include: *The Mediæval Empire* (1898), *Napoleon* (1913), and *Studies in History and Politics*.

Fisher, John, Bishop of Rochester, was born in 1450 at Beverley, in Yorkshire, and graduated M.A. at Cambridge in 1491. In 1501 he received the degree of D.D., and was made chancellor of the university. He was largely responsible for the foundation of Christ's College (1505), and St. John's College (1511) at Cambridge, the necessary money being found by Lady Margaret Beaufort, mother of Henry VII. In 1504 he was promoted to the see of Rochester. He opposed Henry VIII's divorce; listened to the pretended prophecies of Elizabeth Barton, the Maid of Kent; opposed the royal supremacy, and was imprisoned in 1534 and attainted. His appointment as cardinal by Pope Paul III led to his execution after trial by a special commission, 1535. He was beatified by Pope Leo XIII in 1886.

Fisher, John Arbuthnot Fisher, first Baron, Admiral of the Fleet, G.C.B., G.C.V.O., O.M., born 25th Jan., 1841, died 10th July, 1920. At the age of fourteen he entered the navy, and served in the Baltic during the Crimean War. In the Chinese War, from 1859 to 1860, he took part in the capture of Canton and Peiho. Captain of the *Inflexible* in 1882, he was present at the bombardment of Alexandria. He was Director of Naval Ordnance from 1886 to 1891, and a Lord of the Admiralty from 1892 to 1897. Delegate to the Peace Conference at the Hague in 1899, commander-in-chief of the Mediterranean Fleet from 1899 to 1902, he was Second Sea Lord from 1903 to 1904, and First Sea Lord from 1904 to 1910. He introduced the *Dread-*

nought policy and the plan of scrapping old ships instead of keeping them on the Navy List. He resigned his post on account of the severe criticism of Lord Charles Beresford, who put his charges before the Government. An inquiry was held, but the report was favourable to the First Sea Lord, who was raised to the peerage as Baron Fisher of Kilverstone. In 1912 Lord Fisher acted as chairman of a Royal Commission on oil-fuel. Reappointed First Sea Lord in 1914, he resigned on 14th May, 1915, in consequence of a disagreement with Mr. Winston Churchill, then First Lord of the Admiralty. He was chairman of the Inventions Board since 1915, a Grand Cordon of the Legion of Honour, and had received the Order of Merit in 1905.

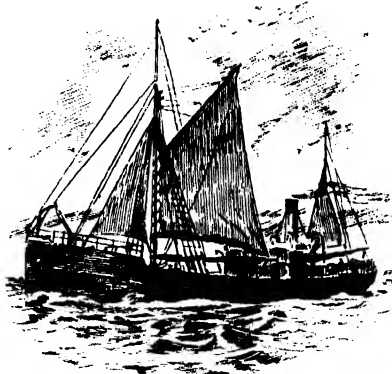
Fisheries. The fishing industries are concerned with the capture and disposal of fish and a great variety of other inhabitants of seas, lakes, and rivers. For the most part the booty is used for food; but aquatic animals yield many useful and ornamental products, in addition to what is edible. For example, sponges, corals, pearls, mother-of-pearl, sealskins, whalebone, and several kinds of oil, for which we are indebted to fishermen, might be mentioned as important commercially. Even the refuse from our common food-fishes is now worked up to yield valuable manures and foods for domestic animals.

The chief fisheries of the world are those of Britain, the United States, Canada, and Newfoundland; but most of the countries that bound the North Sea, the Baltic, and the Mediterranean have a considerable interest in the produce of the waters. France, in addition to developing her home fisheries, has encouraged, protected, and subsidized her fishermen who work in the distant waters of Newfoundland, Iceland, and the North Sea. In the east, Japan has been conspicuous as a great fishery nation, a fact that has much to do with the rapid growth of her naval power.

The products of our fisheries form an important part of the food-supply of the British Isles. Before the European War it was estimated that the home fish-supply equalled in weight one-third of the total meat supply of England and Wales; and the annual value of the take in 1913, exclusive of shell-fish, was put down as above £10,000,000. In Scotland the take, again excluding shell-fish, was valued at close on £4,000,000. During the European War there was of course a great fall-off in the captures; but whereas the average value per hundredweight of 'wet fish' in 1914 is given as 15s. 6d., it had risen by 1918 to £3, 0s. 5d., so that the value of the English sea-fisheries had gone up to fully £14,000,000, and the Scottish catch for the same year was valued at £6,000,000. Since the conclusion of peace there has not been the

success in the fishing industries that many expected. Indeed there seems reason to believe that they are in a critical condition. A period of apparent prosperity in the great trawling fisheries has been followed by a serious decline, largely owing to increased wages, and more especially to the expenses of transport and distribution. The herring fisheries have fared even worse than the others, for their success has always depended on a large export trade, especially to Russia and Germany; and since the European War this traffic has almost ceased. For a time our Government guaranteed a price to the fishermen, and took over their herrings, but early in 1921 it was announced that the guarantee would be withdrawn, and the herring fishermen were faced with an almost hopeless situation. The shell-fisheries too, have come to a period of trial and depression, largely owing to the fact that the public have waked up to realize that enteric fever may be due to the eating of oysters, mussels, cockles, or other shell-fish taken from sewage-polluted waters.

Fresh-water Fisheries.—In the United Kingdom the only fresh-water fish of much importance commercially are the salmon and the eel; and these are both only part-time dwellers in fresh water. The salmon spawns in the upper reaches of many of our rivers, and the young lives in fresh water as a tiny 'parr', generally for two or three years, before putting on silvery dress, and passing down to the sea as a 'smolt'. In the sea this grows rapidly, and it may return to



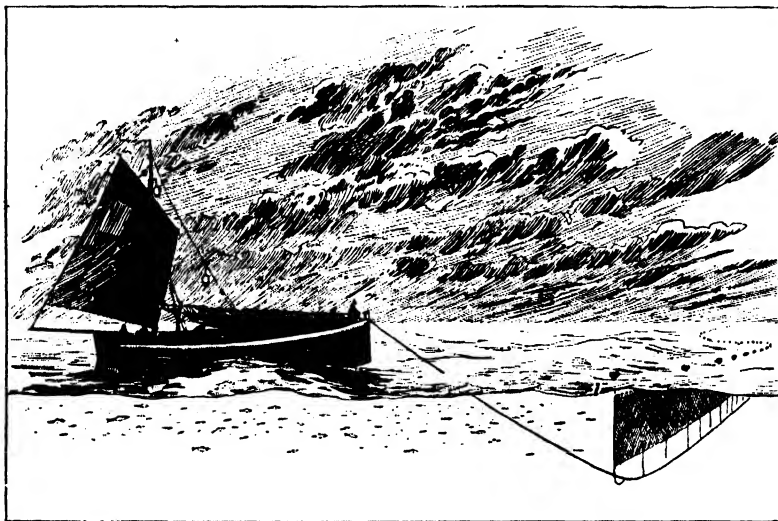
A Steam Trawler

fresh water as a 'grilse' a few months later, weighing as many pounds as it weighed ounces when descending. After spawning it again visits the sea to feed and grow; and this periodic change continues throughout the life of the fish. Salmon are chiefly caught when making for, or actually ascending, rivers with a view

to spawning. They are taken by various forms of net or by artificial flies or other lures.

The story of the eel is the converse of that of the salmon. The eel leaves the fresh water when about to spawn; it migrates far from our shores; and the young eels are hatched out, in a form quite unlike the adult, often many hundred miles from the home of their parents. They drift in the Gulf Stream towards the British coasts; and on reaching our shores, they swarm up our rivers on the quest for good feeding-grounds. After four or five years the spawning instinct develops, and the mature eel

of old, but the 'steam-liners' are able to visit distant waters, and the captured fish are preserved fresh for the market by means of ice. Drift-nets are still used for herring fishing, but the 'steam-drifter' and the motor-driven boat are under control in a quite different way from the old sailing smack. Steam carrying vessels are frequently made use of to convey to market the catch of a fleet of smacks that continue for many weeks on the fishing-grounds. Even for work in home waters experiment has shown the enormous benefit of the motor-engine. One experimental boat, working from Beer in Devon-



Fishing with Drift-net

starts on its great migration, from which it probably does not return. Eels are usually caught when starting on this spawning migration. They are captured in traps and nets as well as by hooks. A station for the capture and distribution of young 'elvers' was established at Epney-on-Severn in connection with the German Fisheries Union. It dealt with as many as 4,000,000 young eels in a year. Since the War it has been taken over by the Board of Agriculture and Fisheries.

Sea Fisheries.—The sea-fisheries of the United Kingdom have developed greatly in recent years. Till well on in the nineteenth century nearly all fishing boats were small and open, and poorly equipped. Now comparatively large, decked vessels are commonly employed, and the use of steam- and motor-engines, with the development of the beam-trawl and the otter-trawl, has added enormously to the effectiveness of the gear. Line-fishing with baited hooks is carried on as

shire, between 20th July, 1915, and 29th Jan., 1916, was able to earn 210 per cent more than the average Beer sailing-boat working the same grounds.

Since vessels driven by steam-power came into competition with smaller craft, there has been steady deterioration of the 'inshore' fisheries; but little groups of fishermen have fought stubbornly to maintain themselves in the fishing villages in face of adverse conditions. In the European War these men rendered enormous service to the country, and now their value is being appreciated, and various plans are being revived or initiated for helping them, and improving their chances of holding their own. In Scotland a scheme of loans for the provision of new boats, the purchase and repair of existing boats, and the purchase of gear was tried for a time, and was given up in 1891, on account of difficulties in collecting the interest. In Ireland the Congested Districts Board and the

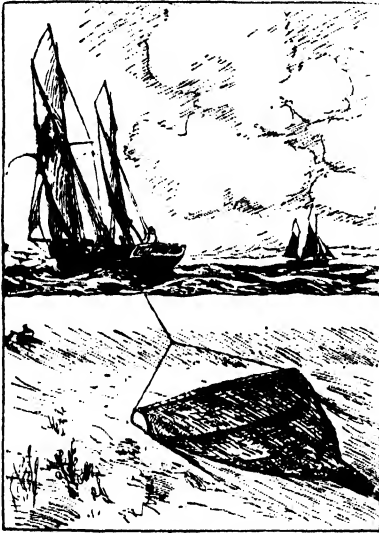
Department of Agriculture offered loans, and did good service by demonstrating new methods of fishing, and by helping to find new markets. In certain districts of England, too, advances were made for the installation of motors, and an important feature of the funds for this purpose was that the fishermen were associated with their administration, and made collectively responsible for their proper application and repayment. In 1913 a Committee appointed by the President of the Board of Trade favoured an extension of the motor-loan scheme, and emphasized the necessity for the immediate

is very marked in the case of some fish—on the population of the sea”. Accordingly there has been general recourse to scientific study of fish, their environment, their habits, and the habits of the organisms on which they feed or which feed upon them. Before the European War an International Council for the Exploration of the Sea had been formed with a view to securing co-operative scientific research among the nations which fish the seas of Western Europe. Nine Powers were represented on this Council, and though its activities were greatly curtailed during the War years, the Council met again in 1920, and took up the threads that were dropped in 1914. It is only by strenuous national and international study of the great fishery problems that salvation for the fisheries can be achieved.

Among the many fishery subjects that have been illuminated by scientific research, the spawn and spawning habits of fish may be mentioned. It was not till 1864 that the great fact was discovered by Sars that our ordinary food-fish have floating eggs. Even at a much later date one often met with absurd arguments against trawling based on the assumption that the eggs of our food-fish were laid on the bottom of the inshore waters. Now it is well established that the vast majority of our edible fish produce pelagic or floating eggs far from the shore. The drift of these eggs has been carefully studied by experiments with floating bottles and otherwise; and it is now known that fishery interests are not local, but that one area may be seriously affected by what is done in neighbouring or even in remote areas.

The growth and movements of young fish have also been fruitful subjects of study. It is now possible in many cases to determine with fair exactness the age of fish by examination either of their scales or of their ear-stones (otoliths). In this way rate of growth in different areas may be ascertained. Experiments in the transplantation of plaice from inshore waters to the Dogger Bank have demonstrated that growth can be greatly accelerated by liberating the fish on rich feeding-grounds. Fish averaging 8½ inches in size, and which if left on the inshore grounds would have added about 2 inches in a year, grew on the average 5½ inches in that period on the Dogger Bank, and increased 382 per cent in weight, as against a probable 100 per cent in the inshore waters.

The question whether the protection of immature fish would lead to a great increase in the number of mature adults has been debated. On the one hand it is urged that the wholesale destruction of the young must lead to a fall-off in number of breeding adults. On the other side it is argued that the taking of many of the full-grown fish will inevitably leave more space and



Fishing with Trawl Net

formation of a Fisheries Organization Society, to promote co-operation amongst fishermen. In Sept., 1914, the Development Commissioners submitted to the Treasury a scheme for the formation of such a society—not trading for profit—and an initial grant of £2000 was made for the purpose. The society is now firmly established and doing admirable work. Since the European War the Development Commissioners have made advances of money to the Board of Agriculture and Fisheries, to the Fishery Board for Scotland, and to the Congested Districts Board for Ireland for the building of boats, the provision of motors, and other assistance to the struggling inshore fishermen.

But the inshore fisheries are not the only ones that have shown a tendency to decline, and, to quote the words of the Tenth Report of the Development Commissioners (1920), “every maritime country has by now discovered that the depredations of man have their effect—which

food for the young, and so will reduce the normal 'infant mortality', and permit of a good deal of destructiveness by man without damage to the fishery. It is now likely that the settling of this most important controversy will be possible as the diminution of fishing in the North Sea during the European War has provided the necessary conditions for testing the facts.

The feeding habits, the migrations, and the spawning seasons of fish have all been investigated with good results. Even the study of the lower animals and plants on which our food-fish ultimately depend has been profitable. Some fish, such as the herring, obtain their nourishment directly from the minute organisms that drift about in the waters, others are indirectly dependent on these, so knowledge of the conditions that determine the paucity or abundance of such drifting forms comes to be of great value for the fishery expert. Already we have investigations published by the Board of Agriculture and Fisheries, aiming at showing how the fluctuations in catches of such fish as pilchards, herring, and mackerel can be referred to changes in the physical and chemical nature of our seas.

In conclusion it may be pointed out that one great result of real insight into the ways of our fish should be that fishery legislation should more and more do what it is meant to do, namely, discourage wasteful methods and encourage all that makes for the prosperity of the species which we wish to abound. By-laws that are not based upon sound knowledge are as likely to hurt as to benefit.—BIBLIOGRAPHY: *Fisheries in the Great War*, being the Report on Sea Fisheries for the years 1915, 1916, 1917, and 1918 of the Board of Agriculture and Fisheries; Professor J. Johnstone, *British Fisheries*; J. T. Jenkins, *The Sea Fisheries*; the Annual Reports of (a) The Board of Agriculture and Fisheries, (b) The Fishery Board for Scotland, and (c) The Lancashire Sea-Fisheries Laboratory.

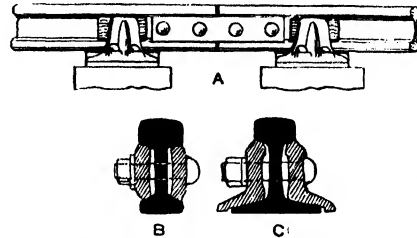
Fishguard (W. 'Abergwaen'), a market town and seaport in North Pembrokeshire, Wales, at the mouth of the River Gwaen and the head of Fishguard Bay, which affords a good sheltered anchorage. An entirely new port and connected works were constructed here in 1906 by the Great Western Railway in connection with the opening of a route to Southern Ireland (by Rosslure). Fishguard is also a general port of call for Cunard and Booth liners from New York and South America. Pop. 2892.

Fish-hawk, a name given in America to the osprey or fishing-eagle (*Pandion haliaetus*).

Fish-hook, a curved, barbed, and pointed steel wire used for catching fish. Redditch in Worcestershire and Limerick are the chief British seats of the fish-hook manufacture. The Limerick hook, which has the greatest reputation, has a

barb that is forged solid, and then filed into the proper shape, while ordinary hooks have a barb that is raised by cutting into the wire. Hook-making machines are now common, especially in the United States, where the wire is run into the machine, and on the other side the hook drops out completed, only needing to be tempered and coloured.

Fish-joint, in railway engineering, a splice or joint where two rails end to end are fastened



A, Two rails joined end to end by fish-plates. B, Cross-section of British standard bull-head rail through fish-plates. C, Cross-section of American T-rail showing angle-bar splice.

together by flat pieces of iron (*fish-plates*) placed one on each side of the rails, and fastened by screw-nuts and bolts. It is essential that the fish-plate should be a tight fit against the top and bottom flanges of the rail. The holes for the bolts are drilled so as to admit of a certain amount of longitudinal movement.

Fish-louse, or **Sea-louse**, a name for several crustaceans of the ord. Copepoda, parasitic on fishes. Some are common on many of the British sea-fishes. *Argulus foliaceus* is found on fresh-water fishes, and even on tadpoles. Sickly fishes often become the victims of multitudes of these creatures, or the sickness is induced by the numbers which attack them.

Fisk University, American educational institution founded in 1866 by Clinton B. Fisk at Nashville, Tennessee, for the education of coloured people.

Fission (from Lat. *findere*, to split), in biology, reproduction by division of one organism of low type into two, each of these, again, dividing into two others, and so on. The products of the division of the body of the primitive organism may either remain connected, when they will give rise to a composite structure (as in many corals), or they may be thrown off and lead an independent existence (as in some of the Hydrozoa).

Fissirostres (-ros'trêz), a tribe of the Insesores or perching birds, distinguished by having a very wide gape, extending beneath the eyes. It comprehends the night-jars or goatsuckers, whip-poor-will, swallows, swifts, martins, &c. But in modern classification this division is often disregarded.

Fissurellidæ, the keyhole limpets, a family of sea-snails resembling the limpets in appearance and habits, but differing considerably in structure. In the typical genus *Fissurella* there is a hole at the top of the conical shell, communicating with the gill-chamber, which contains a pair of gills. The species are widely distributed; some are British and many fossil.

Fistula, in surgery, an abnormal channel, usually caused by the bursting of an abscess, which connects some hollow organ with the surface, such as an anal fistula (a passage from the lower bowel to the skin near the anus), or establishes a communication between two hollow organs, such as the bladder and bowel. It occurs most frequently near some outlet of the body, as the urinary passages and anus.

Fistularia, a genus of teleostean fishes related to the sticklebacks, and characterized by the elongation of the facial bones into a long fistula or tube, at the extremity of which the mouth opens. A notable species is the tobacco-pipe fish, which may attain the length of 6 feet.

Fistulina, a genus of Fungi, allied to *Boletus*, found on old oak, walnut, and chestnut trees, as also on ash and beech; it is much esteemed in some parts of Europe as an article of food. When grilled, it is scarcely to be distinguished from broiled meat.

Fitchburg, an American city, Worcester County, Massachusetts, 40 miles N.W. of Boston; it has manufactures of paper, machinery, and woollen goods. Pop. 40,507.

Fitchet, or **Fitch**, the fur of the polecat. It has a yellow ground, with long, soft, black shining hairs on its surface, which are exclusively used for artists' brushes. The fur is not in great request, as it emits an unpleasant odour which is difficult to dissipate.

Fittonia, a genus of plants, ord. Acanthaceæ, natives of Peru. *F. Verschaffeltii* is cultivated for its ornamental leaves; these bear on the upper side peculiar lens-shaped hairs, which are said to be light-perceiving organs. It is a fact that the leaves place themselves very exactly at right angles to the brightest available light.

Fitz (Lat. *filius*), the old French word for *fil*, son; used as a prefix like the Scotch *Mac*, and the Irish *O'*, in certain surnames, as *Fitzgerald*, *Fitzherbert*, *Fitzmaurice*, *Fitzwilliam*, especially in the surnames of the illegitimate sons of kings or princes of the blood; as, *Fitzroy*, *Fitzclarence*.

Fitzgerald (fits-jeer'ald), Edward, poet and translator, born 1809, died 1883. He studied at Trinity College, Cambridge, and was a friend of Tennyson, Thackeray, and Carlyle. He spent a retired life in Suffolk, occupied with books and boating. His chief work is a translation of *The Rubáiyât* of Omar Khayyâm, the Persian poet (1859). His *Letters and Literary Remains* were

published in three volumes in 1880 by his friend and literary executor, W. Aldis Wright.

Fitzgerald, Lord Edward, born near Dublin 1763, died 1798. He was a younger son of the Duke of Leinster, and married Pamela, the reputed daughter of the Duke of Orleans (Philippe Égalité) and Mme de Genlis. In 1796 he joined the United Irishmen, and plotted for a French invasion of Ireland; was betrayed by a spy, and arrested. He stabbed two of the officers sent to take him, but was disabled by a pistol-shot, which caused his death before he could be brought to trial.

Fitzgerald, Percy Hetherington, novelist and miscellaneous writer, born in Ireland in 1834. Educated at Stonyhurst College, Lancashire, and at Trinity College, Dublin, he was called to the Irish Bar in 1855, and was afterwards appointed a Crown Prosecutor on the North-Eastern Circuit. Besides novels, he wrote many biographical and other works, of which the most important are: *Charles Lamb: his Friends, his Haunts, and his Books* (1865); *Life of David Garrick* (1868); *The Kembles* (1871); an edition of Boswell's *Johnson* (1874); *The Royal Dukes and Princesses of the Family of George III* (1882); *A New History of the English Stage* (1882); *Life and Times of William IV* (1884); *Henry Irving: Twenty Years at the Lyceum* (1893); *Fifty Years of Catholic Life and Social Progress* (1901); and *Memories of Charles Dickens* (1914). He is also a sculptor of ability, his statue of Dr. Johnson standing in the London churchyard of St. Clement Danes. He died in 1925.

Fitzgerald, Lord Thomas, known as 'silken Thomas', born about 1513, died 1537. He was vice-deputy for his father, the ninth Earl of Kildare, on whose arrest by Henry VIII Lord Thomas raised a formidable revolt in Ireland, which was ultimately put down by Skellington, and Lord Thomas and his five uncles were hanged at Tyburn.

Fitzroy, Robert, English admiral and meteorologist, born 1805, died by his own hand 1865. He entered the navy in 1819, and from 1828 to 1836 was employed in hydrographical surveys, and in forming a chain of meridional distances round the globe. On his return he published *Narrative of the Surveying Voyages of H.M. Ships Adventure and Beagle between the years 1826 and 1836, describing their Examination of the southern shores of South America, and the Beagle's Circumnavigation of the Globe*. In 1854 he became superintendent of the meteorological department of the Board of Trade. In 1857 he was promoted to the rank of rear-admiral, and in 1863 to that of vice-admiral. He acquired great popularity with the public for the system of storm-warnings which he established.

Fiume (*Tersattica* *Vitopolis* of the Romans,

Fanum St. Viti ad Flumen of the Middle Ages), a seaport, formerly a free town of Hungary, and since 12th Nov., 1920 (Treaty of Rapallo) an independent state. It is picturesquely situated on the Gulf of Quarnero, in the north-eastern extremity of the Adriatic. It has some good streets and buildings, and its industries embrace paper, tobacco, machinery, chemicals, petroleum, metal goods, and liqueurs. The town came into prominence when the Budapest-Agram- (Zagreb) Fiume Railway was built. The Hungarian Government had spent large sums on the improvement of the harbour, and it became a place of large trade, all the shipping trade of Hungary passing through its port.

The population of the town is mixed, and consists of Italians and Yugo-Slavs. Out of the 49,800 inhabitants (1910) 24,800 were Italians, 13,000 Croats, 2500 Slovenes, and 6500 Magyars. In spite of its mixed population, the industrial development of the town, especially since the creation of the port, was considerable, and it is interesting to note that before the European War the great concerns were mostly Italian and Magyar, whilst the smaller ones were in the hands of the Slavs.

Fiume, under the name of *Vinodol*, is mentioned for the first time in 1200, and the town was a fief of the Patriarch of Aquileia. In 1366 Hugo de Duino received it as a fief from Duke Albert of Austria, but Frederick III of Habsburg bought it in 1407. In 1723 Charles VI created it a free port, and in 1776 Maria Theresa united it to Croatia. It was joined to Hungary as a *corpus separatum* in 1779, annexed by Napoleon as part of Illyria in 1809, occupied by the British in 1813, restored to Austria in 1814, and again to Hungary in 1822. It was reunited to Croatia in 1840, but again annexed to Hungary as a *corpus separatum* in 1869. It was natural that during the European War Fiume, like so many districts with a mixed population, should become a point of discussion. The Italian Irredentists did not perhaps intend to claim the town at first, and the Treaty of London (April, 1915) did not assign it to Italy. But the Committee *Pro Fiuma Italiana* was not idle, and Fiume was at last claimed as Italian; whilst the Yugo-Slavs maintained that it was inhabited by Yugo-Slavs, and both ethnically and historically part of Croatia. President Wilson, when the discussion was raised before the Supreme Council, was against the Italian claim, whilst France and England endeavoured to effect a compromise. Whilst the Supreme Council was still considering the question, a *coup de théâtre* was suddenly effected.

In Sept., 1919, the poet Gabriele d'Annunzio, who had distinguished himself on the outbreak of the war by his eloquent patriotic and imperi-

alistic speeches, and served in the army, seized the city and set up a provisional government. At the head of an expedition composed of mutineers from the army, he went down the short strip of coast which divided the Italian lines from the port, entered the city, and proclaimed its annexation to the Kingdom of Italy. It was a defiance of the Peace Conference, and the Italian Government did not openly recognize the poet's action, although the majority of the Italian public were in sympathy with d'Annunzio. Ordered to evacuate the city, he refused to obey, and even the declaration of a blockade did not move him. In the meantime the Treaty of Rapallo was signed by the representatives of Yugo-Slavia and Italy on 12th Nov., 1920, and the independent state of Fiume was established. D'Annunzio, however, and the insurgents denounced the treaty and declared a state of war with Italy. A blockade was declared by the Italian Government, and in Jan., 1921, d'Annunzio and the insurgents were at last compelled to yield, and evacuated the town.

Five Forks, a locality in Dinwiddie County, Virginia; the scene of an important battle fought 1st April, 1865, one week before the close of the Civil War. After heavy fighting, the Confederates were completely defeated.

Five Mile Act, an Act of Charles II (1665) forbidding nonconformist clergymen who refused to take the oath of non-resistance and swear to attempt no alteration of the constitution in Church or State, to come within 5 miles of any corporate town where they had preached since the Act of Oblivion. They were also prevented from keeping schools. The Act was repealed in 1688.

Fives, a ball game of considerable antiquity. The name is almost certainly derived from an essential feature, the use of the five fingers, 'fives' being a slang expression for the hand, a much more probable derivation than such suggestions as that five players originally took part in a game, or that five points have to be scored by the winners.

Reduced to fundamentals, the game consists in hitting with the palm and fingers, which are protected by a padded leather glove, a small hard ball. The ball must be struck before it has bounced more than once, and it must strike a wall above a certain line. An 'open court' comprises merely a level piece of ground and a smooth wall in front; a 'closed court'—the more usual kind of court—has two walls at right angles to the front one, and a back wall to complete a square or rectangle, so that any or all of the four walls may be struck by the ball during its passage.

The ball has an india-rubber core; it is bound with fine twine, and covered with white leather.

There are two forms of the game of fives, known as the Eton and the Rugby game. The main features are identical in both, viz. the serving of the ball to the opposing striker, and the necessity of hitting it before the second bounce and of ensuring its striking the front wall above the base line. One difference, however, is that although in the Rugby game singles or doubles may be played, in the Eton game a contest between two individuals only is impracticable and rarely undertaken.

The original Eton game was played against the chapel wall, with the buttresses constituting side walls; the balustrade of the chapel steps projected into the court. These conditions are represented in a modern 'Eton court' by a paved floor, the front of which is raised 5 inches above the back, forming a step. This type of court has no back wall. Along the left lateral wall at its middle point a projection is erected to act as an obstacle; it is colloquially known as 'the pepper-box', and is a special feature of the game, in which the object is to serve the ball into the 'pepper-box' so that it strikes it and emerges at an angle, making it difficult for one of the opponents to reach it and return it. The striker loses a point if the ball passes too high over 'the pepper-box'. A game is fifteen points, a point being scored when the ball is struck outside the reach of an opponent. The right to serve is lost if the ball is struck below the prescribed line, or, as has already been explained, if it passes too high over the projecting 'pepper-box'. It is obvious that a very lengthy game may ensue if the opposing sides keep on alternately gaining the right to serve, no point being scored. On the other hand, a superior side may win the whole fifteen points without their opponents ever finding an opportunity to score. The balls are $1\frac{1}{2}$ inches in diameter, and weigh $1\frac{1}{2}$ ounces.

The Rugby Game.—The size of court varies considerably. The game is much simplified by the absence of the 'pepper-box'; there is usually, but not invariably, a back wall. The balls are rather smaller than those employed in the Eton game. Scoring is identical in both games.

Whilst some primitive and elementary representation of the game is fairly universal, fives is more particularly played at the British public schools. At several, both varieties of court exist and both varieties of the game are played, but on the whole every school remains faithful to one or other variety. The Eton game is particularly favoured at Eton, Harrow, Westminster, Charterhouse, Repton, Shrewsbury, and Wellington. The Rugby game is preferred at Rugby, Winchester, Marlborough, St. Paul's, Bedford, Oundle, and Clifton.—Cf. A. Tait, *Fives* (All England Series).

VOL. V.

Fixed Stars, a name applied to the stars proper, as distinguished from the planets. The term is appropriate, because the stars for long periods of time preserve practically the same apparent positions with reference to each other. Their light is intrinsic, and not borrowed, and our sun itself is but one of the fixed stars. See *Stars*.

Fixtures (Lat. *figere*, to fasten), in law, are accessories annexed to houses or lands, which by the fact of their being so annexed become a part of the real property and pass to the freeholder, not being removable at will by the tenant or occupier of the property. The general rule of law is that whatever has been affixed to the premises or put into the land by a tenant during his occupancy cannot be removed without the landlord's consent. Large exceptions are made to this rule in favour of the tenant, covering generally fixtures for trade, for agricultural purposes, and for ornament or convenience; but the removal must not injure the land or buildings of the landlord.

Fizeau, A. H. L. (1819-96), a French physicist who made important experiments on light. He was the first to determine the velocity of light by a terrestrial experiment. A ray of light was sent so as to be reflected back to the starting-point by a distant mirror. A toothed wheel was interposed in the path of the ray, and was rotated at such a speed that the outward ray passed between one pair of teeth, and the reflected ray between the adjacent pair. The speed of light was then found by a simple arithmetical calculation. Another experiment of Fizeau's is often referred to at the present day in discussions of the vexed question of the relative velocity of ether and matter. This experiment proved the correctness of the formula given by Fresnel for the velocity of light in a material medium moving relative to the earth. See *Ether*; *Light*.

Flag, a popular name for many monocotyledonous plants with sword-shaped leaves, mostly growing in moist situations; but sometimes particularly appropriated to *Iris pseudacorus*, nat. ord. Iridaceæ; also termed *Flower de lis* or *Flower de luce*. It has sword-shaped leaves and yellow flowers, grows in marshy places and by the sides of streams and lakes. The stout creeping rootstock has been recommended for alleviating the toothache, and is used for dyeing black in the Hebrides. The leaves make excellent thatch, and are also employed for making bottoms to chairs.

Flagellants (flaj'el-ants; Lat. *flagellare*, to lash or scourge), the name of a sect in the thirteenth century who maintained that flagellation was of equal virtue with baptism and other sacraments. They walked in procession with

shoulders bare, and whipped themselves till the blood ran down their bodies, to obtain the mercy of God and appease his wrath against the vices of the age. Rainer, a hermit of Perugia, is said to have been their founder in 1260. He soon found followers in nearly all parts of Italy. Their number soon amounted to 10,000, who went about, led by priests bearing banners and crosses. They went in thousands from country to country, begging alms; and for centuries they formed a sort of intermittent order of fanatics, frequently reappearing here and there in times of extraordinary declension or distress. Their doctrines were condemned by the Council of Constance (1414-8), and they gradually disappeared after the middle of the fifteenth century.—Cf. W. M. Cooper, *Flagellation and the Flagellants*.

Flageolet (flaj'e-let), a sort of small flute or whistle played by means of a mouthpiece. The tone produced is similar to that of the *piccolo*, but is softer in quality, and the range is two octaves. The double flageolet consists of two instruments united by one mouthpiece, and producing double notes. The name *flageolet tones* is given to those harmonic tones on the violin, violoncello, and other stringed instruments, produced by the finger lightly touching the string on the exact part which generates the harmony, and not by pressing the string down to the finger-board. The flageolet was employed by Mozart.

Flag-officer, in the British navy, a general distinguishing title for an admiral, vice-admiral, and rear-admiral, who have the right to carry flags indicating their rank at the mast-head.

Flag of the Prophet, the *Sanjak-sherif*, or sacred flag of the Mohammedans. It was originally composed of the turbans of the Koreish captured by Mohammed; but the black curtain that hung in front of the door of Ayesha, one of Mohammed's wives, was afterwards substituted. It is preserved in the seraglio at Constantinople. The carefully-guarded banner unfolded at the commencement of a war is not the real sacred flag, though it is commonly believed to be so.

Flag of Truce. Properly speaking, this means the white flag which is carried as a distinguishing mark by an envoy deputed to carry a message from one belligerent in the field to his opponent. By general custom it is applied to all the persons collectively forming the mission. The laws and customs of war recognize the possibility of occasional necessary intercourse between belligerents, and provision is made for the proper conduct of all such negotiations (Hague Convention, Chapter III). A commander wishing to communicate on any matter with the commander of an opposing force deposes an officer

to represent him. This officer, known as the *parlementaire*, must be provided with a written authority signed by the commander, and on his mission may be accompanied by not more than three other persons, viz. a trumpeter, a flag-bearer, and an interpreter. All the persons composing a 'flag of truce' are entitled to inviolability as far as the natural chances of war admit, i.e. the enemy may not take any hostile action against them personally, provided the 'flag of truce' makes no attempt to engage in espionage (q.v.). Should a 'flag of truce' see or hear anything in a quite open way, he may legally report it to his own commander, and this is not espionage; but it follows that the enemy commander to whom the 'flag of truce' surrenders himself must take every precaution to prevent such a thing happening, and this invariably takes the form of blindfolding every member of the flag of truce. A commander is not obliged to receive a flag of truce, in which case it must return directly to its own lines.

Flags, National. Flags were in use in very early times, being displayed in war by the Egyptians and the Saracens. The Romans marched to battle under the eagle, while the Greek emblem was Athena's owl. In the Bayeux tapestries may be seen numerous flags carried by the Norman invaders of Britain. One of the earliest records of an English battle standard is in 1138, when, at the battle of Northallerton, triple flags—those of St. Peter, St. John of Beverley, and St. Wilfrid of Ripon—were displayed from a mast which was surmounted by a silver pyx and borne on a wheeled car. In 1244 Henry III caused to be made a standard of crimson silk representing a dragon, richly adorned with gold and having eyes of precious stones. The red cross of St. George on a white field, and the white cross of St. Andrew (saltire) on a blue field, were the national flags of England and Scotland respectively at a time prior to the reduction of heraldry to a science. In 1606 these two flags were, by order of James I, combined in one; the St. George's Cross being placed over the white saltire, and given a narrow white border in order to avoid the heraldic solecism of placing colour upon colour. On the admission of Ireland into the Union in 1801 the Cross of St. Patrick, a red saltire on a white ground, was added, being placed side by side with that of Scotland. This flag is still carried by warships on a 'jack' or jack-staff at the point of the bowsprit; hence the common name of 'Union Jack', mistakenly supposed by some to be an allusion to King James, and by others to the English soldier's former *jacque* or surcoat, which often bore a red cross. The *Royal Standard* of the United Kingdom displays in two of its quarters the

royal lions of England, the remaining ones being occupied respectively by the Scottish lion and the Irish harp. This flag is personal to the sovereign, being hoisted upon any place in which he is in residence, on certain home and foreign stations, and during state ceremonies. The three *ensigns*, *red*, *white*, and *blue*, are a survival from the period prior to 1864, when the British fleet consisted of three divisions so named. The *white ensign*, which differs from the other two in having a St. George's Cross upon its field in addition to the Union flag in the upper quarter next the staff, is flown by the Royal Navy and the Royal Yacht Squadron; the *red ensign*, with the Union flag in the corner, by merchant ships in general; and the *blue ensign*, differing from the *red* only in the colour of the field, by the Royal Naval Reserve and certain privileged yacht clubs. *United States*.—To the 'stars and stripes' of the United States has been long attached the doubtfully authentic legend which would derive its design from the *bars* and *mullets* of the Washington coat-of-arms. During colonial days the flag was of horizontal stripes, the Union device of Great Britain appearing in the upper corner. Shortly after the Declaration of Independence this flag gave place to one having thirteen stripes, of red and white alternately, as representing the thirteen original states of the Union; with thirteen stars in place of the British emblem; all being on a blue field. In 1808 the stars—but not the stripes—were increased to twenty in number, seven new states having been incorporated in the Union. A star was added for each new state subsequently admitted, the number now being forty-eight. In the flag of the United States navy the devices are separated, the admiral's flag bearing the stripes only, while the stars are shown upon a 'jack'. The national flag of *Denmark*, particularly interesting as dating from the thirteenth century, and thus being probably the oldest in existence, is (for the navy) swallow-tailed in form, a white cross on a red field. The standard is similar in shape, but with the royal arms added at the centre of the cross; the merchant flag is rectangular. *France*.—The early royal standard of France was the blue hood of St. Martin, to which succeeded the red oriflamme that formed the standard of the abbey of St. Denis. In the fifteenth century this was replaced by a blue standard covered with *fleurs-de-lis*, these being later reduced in number to three, as in the royal arms. The white standard came into use under Henri IV. In 1794 appeared the tricolor with its three vertical divisions of blue, white, and red. Napoleon retained this unchanged until his elevation to imperial power, when the standard was powdered with golden bees, a device revived under the second empire.

At the Bourbon restoration the white flag had once more come into use, retaining its place until it yielded to the tricolor in 1830. *Germany*.—The flag of the German merchant service remains unchanged by the European War, being three horizontal stripes—black, white, and red; but the iron cross, black eagles, and imperial crown which formerly adorned the standard have now disappeared in favour of three horizontal stripes—black, red, and gold. *Holland*.—The flag of the *Dutch* mercantile marine is of three horizontal bars—red, white, and blue; that of *Belgium*, vertical bars, black, yellow, and red, while the standard bears the royal achievement on the middle stripe. The *Spanish* naval flag is of three horizontal stripes, the broader middle stripe being yellow, and the others red; the merchant flag is yellow, crossed by two horizontal bars of red. The flag of the *Italian* mercantile marine displays three vertical stripes, respectively green, white, and red. The flag of *Russia's* merchant fleet is white, blue, and red in horizontal bars; under the old régime her navy flew a blue saltire on a white field. The *Swedish* navy has a yellow cross on a blue field; that of *Norway* has a blue, white-bordered cross on red. The *Greek* naval flag shows nine horizontal stripes, alternately blue and white, the upper quarter next the staff having a white cross on a blue field. *Japan's* naval flag is a red rising sun, emitting rays of alternating red and white. Several new flags came into existence as a result of the European War. The flag of *Estonia* has blue, black, and white in horizontal stripes, whilst that of the *Kingdom of Hedjaz* has black, green, and white in horizontal stripes. The flag of *Latvia* is red, white, red horizontally, whilst the new flag of *Yugo-Slavia* is blue, white, red horizontally. The new flag of *Austria* has red, white, red in horizontal stripes of equal width.—BIBLIOGRAPHY: E. Hulme, *Flags of the World: their History, Blazonry, and Associations*; A. MacGeorge, *Flags*; W. Bland, *National Banners; Flags of all Nations*.

Flagstone, any sandstone, limestone, &c., that is cut or split readily into thin layers, and may be used for pavements or floors.

Flahaut de la Billarderie (flā-ō dē lā bē-yār-drē), Auguste Charles Joseph, Comte de, French general and diplomatist, born 1785, died 1870. He had a brilliant career under Napoleon I, but on the return of the Bourbons he left France and lived in exile from 1815 to 1830. He married in England Admiral Lord Keith's daughter, who became Baroness Keith in 1823. He returned to France in 1830, and was Ambassador successively at Berlin, Vienna, and London.

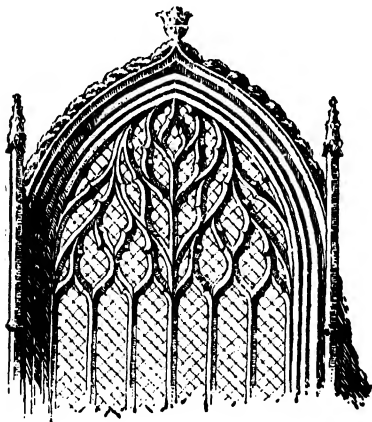
Flambard, Rannulph or Ralph, a Norman of humble origin who became the chief minister of William Rufus. He was early connected with

the Conqueror's court, and, being handsome, clever, and unscrupulous, he gained great influence with the king, and rose to still greater favour with Rufus, whom he encouraged in his tyrannical and rapacious courses. His flagrant extortions earned the hatred of the people, and his character is painted in the blackest characters by the chroniclers. In 1099 he was made Bishop of Durham; but on the death of William he was committed to the Tower by Henry I. He managed to escape, however, by a rope conveyed to him in a vessel of wine, and instigated Robert, Duke of Normandy, to invade England. He was subsequently forgiven by Henry and restored to Durham, where he afterwards lived peaceably, much engaged in architectural works connected with the city and the cathedral, till his death in 1128.

Flamborough Head, a headland on the east coast of England in Yorkshire. It consists of a lofty range of chalk cliffs about 6 miles long and from 300 to 450 feet high. On the extreme point of the promontory, at a height of 214 feet above sea-level, is a lighthouse 87 feet high, with a revolving light visible from a distance of 20 miles.

Flamboy'ant, or **Gold-mohur Tree** (*Poinciana regia*), a leguminous tree, a native of Madagascar, but cultivated all over the tropics for the sake of its magnificent crimson and white flowers. It is a feature of the renowned sea-front of Rio de Janeiro.

Flamboy'ant, a term designating a style of Gothic architecture in use in France about the

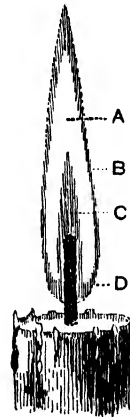


Flamboyant Tracery, St. Mary's, Dinan, fifteenth century

same period with the Perpendicular style in England, that is, from the fourteenth to the sixteenth century, having prevailed during the whole of the fifteenth century. It was distinguished by the waving and somewhat flame-

like tracery of the windows, panels, &c. (hence the name), and is usually regarded as a decadent variety of the decorated Gothic. The mouldings in this style are often ill combined, some of the members being disproportionately large or small. The pillars are often cylindrical, either plain or with a few of the more prominent mouldings of the arches continued down them, without any capital or impost intervening. This is so common that it may be regarded as a characteristic of the style. Mouldings also sometimes meet and interpenetrate each other. The arches are usually two-centred, sometimes semicircular, and, in later examples, elliptical. The foliage enrichments are usually well carved, but the effect is often lost from the minuteness and intricacy of the parts.

Flame, a blaze rising from a burning body, or any inflammable gas in a state of visible combustion. Flame is attended with great heat, and sometimes with the evolution of much light; but the temperature may be intense when the light is feeble, as is the case with the flame of burning hydrogen gas. The flame of a candle may be divided into three zones: an inner zone containing chiefly unburned gas, another zone containing partially-burned gas, and an outer zone where the gas is completely consumed by combination with the oxygen of the air. The luminosity of flame depends upon the presence of extremely small particles of solid matter (usually carbon) or of dense gaseous products of combustion. When the pressure of the gas producing the flame is so great that it is all but flaring, it is found that certain sounds will cause the flame to alter its shape, thus producing the phenomenon of *sensitive flames*.



Flame

A, Bright part, of partially burned gas. B, D, Outer zone, completely consumed gas. C, Inner zone, unburned gas.

cause the flame to alter its shape, thus producing the phenomenon of *sensitive flames*.

Fla'men, among the ancient Romans the name given to any priest devoted to the service of one particular deity. Originally there were three priests so called: the *Flamen Dialis*, consecrated to Jupiter; *Flamen Martialis*, sacred to Mars; and *Flamen Quirinalis*, who superintended the rites of Quirinus or Romulus. The number was ultimately increased to fifteen, the original three, however, retaining priority in point of rank, being styled *Majores*, and elected

from among the patricians, while the other twelve, called *Minōres*, were elected from the plebeians. The wife of the *Flamen Dialis* was called *flaminica*, and was a priestess of Juno.—Cf. Sir J. G. Frazer, *The Golden Bough*.

Flame-throwers. Fire and war have always been associated ideas, and incendiary devices have been employed in battle from prehistoric times. Samson's exploit with the foxes is an early instance, while the mixtures from which the Chinese developed gunpowder were invented for incendiary purposes. The celebrated 'Greek Fire' by means of which Constantinople was defended from the barbarians during the decay of the Eastern Empire is the most memorable example in history, and the composition of this substance was a jealously-guarded secret. In the museum of the Tower of London is the iron lattice framework of a mediæval incendiary bomb intended to be thrown from a catapult. Such bombs were made as large as 2 feet in diameter, and red-hot shot for setting on fire hostile ships were much used in naval actions in later days when the use of fire in land-warfare had come to be considered barbarous.

The German use of *Flammenwerfer* in conjunction with poison-gas (q.v.) in 1915 forced the Allied armies to adopt retaliatory measures, because although the actual results achieved by the German *flammenwerfer* were surprisingly small, the moral effect of an unknown and terrifying weapon is always considerable until its possibilities and limitations can be demonstrated to troops. On its first employment most exaggerated reports of the range and effectiveness of the German *flammenwerfer* were widespread, and these were not dissipated until specimens had been captured by British troops and examined and tested in the Army Central Laboratory. The small German *flammenwerfer* consisted of a tank so shaped and fitted that a man could carry it on his back. This formed the reservoir, and was filled about two-thirds full with an easily ignited liquid consisting of a mixture of creosote, wood alcohol, and other wood distillates. To provide means to expel this liquid, nitrogen was forced into the space above the liquid from a cylinder until the pressure was about 200 lb. per square inch. The nitrogen cylinder was then disconnected: a gauge enabled the operator to ascertain whether the pressure was correct. The liquid was discharged through a valve controlled by the operator. This valve was connected by a flexible tube to a length of rigid tube about 4 feet long provided with a nozzle. Ignition was by means of an inflammable ring, which was itself lighted by a percussion cap which was fired by impact of the jet of liquid when the valve was opened. The diameter of the nozzle was about $\frac{1}{4}$ inch, and

the weight of the complete apparatus about 80 lb. The total time of discharge (which could be continuous or in short bursts at intervals) was about 7 seconds, and the maximum range only 28 yards. When investigation had demonstrated the limitations and more obvious disadvantages of the small German *flammenwerfer*, the British General Staff wisely decided that apparatus so vulnerable would be useless for offensive purposes, and would prove a source of danger rather than assistance to our troops unless a range greater than that for bombing (40 yards) could be obtained.

The Germans had a larger device for stationary use in trenches, which weighed about 4 cwt. and had a range of 50 yards. This could have been employed only for defence, because the opposing trenches were always more distant than 60 yards (apart from isolated look-out, listening, bombing, and sentry posts).

The only large apparatus which was employed in offensive operations was the *Livens Large Flammenwerfer*, a British invention (the work of Captain W. H. Livens, D.S.O., M.C., and Mr. F. H. Livens, M.C.E.). This embodied new principles and was designed to operate not from trenches but from the underground mine galleries or Russian saps which were driven out to the enemy trenches along the greater part of the British front. The *Livens* apparatus had a range of 100 yards, and as the jet could be brought as close to the enemy as was required, and could be swung through a large arc, enemy works on a front of 150 yards could be subjected to fire by each *flammenwerfer* to a depth of 80 yards. The apparatus consisted of a long steel barrel built up in sections clamped together; it was 9 inches internal diameter, and could be extended to any required length and oil capacity (it was 30 feet long on occasion). The tube, or barrel, had a floating piston in it and was filled with oil. At the moment of firing, compressed gas was admitted behind the piston, and the piston forced out the liquid through the jet. The jet remained underground until the moment of firing, and was provided with a steel hood, and this hood had a cutting blade, so that the ground above the jet remained unbroken until the signal came to fire, when the jet was forced up under oil pressure, and the steel hood broke through the last few inches of soil. After firing, the jet sank back and nothing, save a small hole indistinguishable among grass and shell-holes, remained to betray the presence of the apparatus. If necessary a system of supply tanks enabled the apparatus to be fired three times consecutively at intervals of a few seconds, and over a ton of oil could be discharged.

This apparatus was used with great success at the commencement of the Somme battle in

July, 1916, and also in the taking of High Wood and other difficult positions. The incendiary material used consisted of a mixture of petroleum distillates, the propellant nitrogen or deoxygenated air, the pressure used being about 350 lb. per square inch.

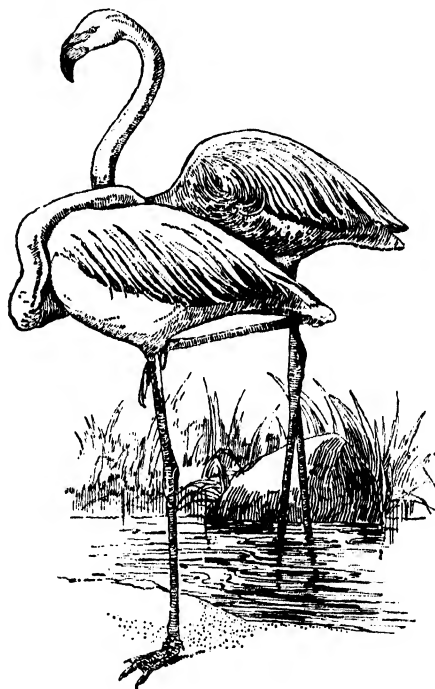
Consideration will make it clear that the only advantage of a flammenwerfer over incendiary bombs and shells is the large area swept by flame, and against this advantage must be set the short range, the necessarily elaborate, vulnerable, and heavy nature of the apparatus, and the large amount of labour involved in installation. With nozzles of known types the distance the liquid is thrown depends upon the diameter of the nozzle as well as upon the application of suitable pressure and the nature of the liquid, and such very large quantities of oil are required to supply large nozzles that 1½ inches is the maximum size of nozzle that is practicable, and the maximum ranges possible are between 100 and 120 yards when conditions are favourable, and are greatly lessened by cross or head winds.

Flammenwerfer were therefore superseded before the end of the War in the Allied armies by the Livens Projectors. These were created principally for use in gas warfare, and were 8-inch calibre mortars, capable of throwing 65-lb. bombs 2000 yards. These were fired electrically in salvoes of up to 6000 mortars at a time, and by means of them woods could be deluged with fire, or lakes of fire several acres in extent could be created over enemy positions, fortifications, and villages. The Livens Drum (or bomb) consisted of a very light steel sausage-shaped casing, stayed internally by a steel tube containing the fuse parts and bursting charge, and filled for incendiary purposes with cotton-waste balls and a mixture of Mexican fuel oil two-thirds and crude petrol one-third, or thermite, or a spontaneously inflammable liquid containing phosphorus, or a solidified oil mixture. The bursting charge consisted of ophorite (an explosive invented by Professor J. F. Thorpe, C.B.E., F.R.S., which gives an intense flame) or black powder. Incendiary bombs were largely used by aeroplanes and incendiary shells from guns.

Those who wish for information at greater length on this subject will find it in two admirable articles on *Incendiaries in Modern Warfare* by Captain Arthur B. Ray, late C.W.S., in the *American Chemical Society's Journal of Industrial and Engineering Chemistry* (July and Aug. numbers, 1921).

Flamin'go, a bird of the genus *Phœnicoptærus*, constituting a family *Phœnicopteridæ*, coming half-way between storks and geese. Its body is rather smaller than that of the stork, but owing to the great length of the neck and legs

it stands from 5 to 6 feet high. The beak is naked, lamellate at the edges, and bent downwards as if broken; the feet are palmated and four-toed. The common flamingo (*P. roseus*) ranges from Central Europe through Africa, and into Asia as far as Lake Baikal, India, and Ceylon. It is entirely scarlet, except the quill-feathers, which are jet-black. The tongue is fleshy, and one of the extravagances of the Romans during the later period of the empire was to have dishes composed solely of flamin-



Flamingoes (*Phœnicoptærus roseus*)

goes' tongues. The flamingoes live and migrate in large flocks, frequenting desert sea-coasts and salt-marshes. They are extremely shy and watchful. While feeding they keep together, drawn up artificially in lines, which at a distance resemble those of an army; and, like many other gregarious birds, they employ some to act as sentinels, for the security of the rest. Their food appears to be mollusca, spawn, crustaceans, &c., which they fish up by means of their long neck, turning their head in such a manner as to take advantage of the crook in their beak. They breed in companies in inundated marshes, raising the nest to a certain height by heaping up the mud with their feet into a small hillock, which is concave at the top. In this the female lays her

eggs, and it was formerly believed that she sat on them with her legs hanging down, like those of a man on horseback. But the nests are not so high as to allow of this, and the birds really sit with their legs doubled up under them. An American species of flamingo is *P. ruber*, which ranges from Florida to South America, and there are three species peculiar to the latter.

Flaminian Way (*Via Flaminia*), the principal northern road which led from ancient Rome. It was constructed by C. Flaminius the elder in 220 B.C. during his censorship, and led from Rome to Ariminum (Rimini) on the Adriatic, 222 miles. Remains of it are yet extant in various places.

Flaminius, Titus Quinctius, Roman general, born about 230 B.C., died about 174. He was quæstor in 199, consul in 198, terminated the Macedonian War by the defeat of Philip at Cynoscephalæ 197, and proclaimed at the Isthmian games in 196 the independence of Greece.

Flamin'us, Gaius, Roman general, was tribune in 232 B.C., prætor in 227, consul in 223, censor in 220, and again consul in 217. He had a triumph for defeating the Insubrian Gauls; and during his censorship (220 B.C.) he constructed the Flaminian Way and built a circus. In 217 he was sent against Hannibal into Etruria, and was defeated and killed in the battle of the Trasimene Lake (23rd June).

Flammarion, Camille, French astronomer, born at Montigny-le-Roi (Haute-Marne) on 26th Feb., 1842. He first studied theology at Langres, which perhaps accounts for the mysticism pervading some of his works. In 1858 he came to Paris, entered the Observatory as a student, and was transferred in 1862 to the Bureau des Longitudes. He made several balloon ascents for the purpose of studying the upper regions of the atmosphere. For some time he edited the *Cosmos* and the scientific columns of the *Siècle*, and in 1882 he founded the monthly magazine *L'Astronomie*. Flammarion also started the French Astronomical Society in 1887, and several other societies both in France and in the United States. He is one of the most imaginative and popular writers on astronomy. His works include: *Les Mondes imaginaires et les mondes réels* (1864), *La Pluralité des mondes habités* (1862), *Dieu dans la nature* (1866), *Les Merveilles Célestes* (1865), *Voyages Aériens* (1868), *Histoire du ciel* (1872), *L'Atmosphère* (1872), *Les Terres du ciel* (1884), *Le Monde avant la création de l'homme* (1886), *Uranie* (1892), *La Fin du monde* (1893), *L'Inconnu et les problèmes psychiques* (1900). He died in June, 1925.

Flammwerfer. See *Flame-throwers*.

Flamsteed, John, the first Astronomer Royal of England, was born 1646, died 1710. He graduated at Cambridge in 1674, took orders in the

Church, but devoted himself chiefly to mathematical and astronomical pursuits. He was appointed by Charles II astronomical observator to the king, and carried on his observations at the Queen's House at Greenwich, until the observatory was built for him in 1676. Here he passed his life, formed the first trustworthy catalogue of fixed stars, and supplied the lunar observations by means of which Newton verified his lunar theory. His great work *Historia Cælestis Britannica* was finished in 1723. In 1832 the discovery of a collection of his letters disclosed a protracted quarrel between him and Newton.

Flanders, a region of Europe, now included in Holland, Belgium, and France, stretching along the North Sea. The erection of the territory into a county took place in the ninth century, and was made by Philip the Bold, King of France, in favour of his son-in-law, Baldwin. It afterwards passed to the united Houses of Spain and Austria, and ultimately to the latter, but underwent considerable curtailment by the conquests of the French in the west, when part of it became French Flanders, and by the conquests of the Dutch in the north. The remainder still retains its ancient name, and forms the modern provinces of East and West Flanders, in Belgium.—The Belgian province of *East Flanders* (Fr. *Flandre Orientale*) has an area of 1158 sq. miles. The surface forms an extensive plain, sloping gently eastwards. It wholly belongs to the basin of the Scheldt. Its soil, partly of a sandy and partly of a clayey nature, is so industriously and skilfully cultivated that it has the appearance of a vast garden. The principal crops are wheat and flax. Linen, laces, and Jamask are among the important manufactures. Gand or Ghent is the capital. Pop. 1,133,882 (1918).—*West Flanders* (Fr. *Flandre Occidentale*) has an area of 1240 sq. miles. The surface is generally flat; the soil naturally sandy and poor, but well cultivated and fertilized, though not so productive as that of East Flanders. The most important branch of industry is linen. Great quantities of lace also are made. Bruges is the capital. Flanders has always been 'the cock-pit of Europe', and during the European War (q.v.) it was the scene of some of the fiercest and most prolonged battles. Ypres especially, as being the key to the Channel Ports, was the chief storm-centre of the fighting of the British and Imperial armies. The three Battles of Ypres, each including many subsidiary battles, took place in 1914, 1915, and 1917. Pop. (1918), 879 032.

Flange, a rib or rim which is given to an object for the purpose of strengthening it or limiting its position or motion, for example, the top and bottom flanges of an 'I' girder, the flange of a railway wheel, the flanges on the end

of a pipe by which one pipe is attached to the next by means of screw-nuts and bolts.

Flank, in fortification, that part of a work which affords a lateral defence to another. In military tactics flank signifies the outer extremity of the wing of an army, or of any division of an army, as of a brigade, regiment, or battalion.

Flannan Islands, or **Seven Hunters**, a group of uninhabited rocky islands in Scotland, in the Outer Hebrides, county of Ross and Cromarty, 21 miles w.n.w. of Lewis. They contain some ancient monuments supposed to be religious.

Flannel, an all-wool fabric, woven plain, and at one time largely used for all kinds of underwear. Its only defect was the natural property of shrinking brought about by the milling or fulling action due to absorption of perspiration and to repeated washings. The wool may now be treated to minimize this defect, but within the last two decades such cloth has been largely supplanted by various kinds of hosiery fabrics, and somewhat similar open-work woven fabrics for next-to-skin wear. Flannel cloth is still largely used for children's underwear, sports suits, shirts, and the like, either in whites, greys, fawns, or decorated with coloured stripes. The cloth is made in all the countries of the United Kingdom, but principally in West Yorkshire, East Lancashire, West of England, and Wales. Union flannel (so-called) shirtings are often striped with cotton threads for cheapness and to minimize shrinkage.

Flannelette, an all-cotton fabric, made to imitate flannel as much as possible in appearance by raising mechanically the soft thick cotton weft to form a nap or fluffy surface on both sides of the fabric. It is woven either plain or twill, almost invariably contains attractive coloured stripes, and is used extensively and almost exclusively for sleeping garments and underclothing. On account of the exuberance of projecting fibres, the fabric is easily set on fire, and hence caution should be exercised when wearing flannelette clothing. Newly manufactured flannelette is often treated to resist combustion.

Flash Boiler, a small tubular boiler into which a spray of water is injected which almost instantly vaporizes into steam. These boilers are used on steam-driven motor-buses, and work at a high pressure, some 500 to 600 lb. per square inch.

Flash Point. See *Petroleum*.

Flat, a character or sign in music, used to lower or depress, by the degree of a semitone, any note in the natural scale. It is marked thus ♭. An *accidental flat* is one which does not occur in the signature, and which affects only the bar in which it is placed.

Flat-fish, a fish which has its body of a flattened form, and swims on one side. The side

facing downwards is pale in colour, while that facing upwards is dark and bears both the eyes. In turbot and brill the eyes are on the *left* side, but they are on the *right* side in plaice, flounder, dab, halibut, and sole. The sense is sometimes extended to other fishes which have the body much compressed from above downwards, as the skate and other members of the ray family.

Flathead Indians, a name applied to several different American tribes that flatten the skull of the infant by pressure. The practice is now nearly extinct. In the United States the Catawa and Choctaw in the south-east were known as Flatheads, but nearly all the Muskogean, Natchez, and Tonika tribes were addicted to the practice of artificial deformation of the head. On the north-west coast most of the Salish of Puget Sound and British Columbia, the Chinook of Columbia River, and many of the Indians of Vancouver Island were known collectively as Flatheads. But the Salish proper, now known in official reports as Flatheads, never flattened the head. Cranial deformation is a widespread practice in parts of Europe, Asia, Oceania, and America, and is one of the most striking illustrations of the spread of culture in ancient times.

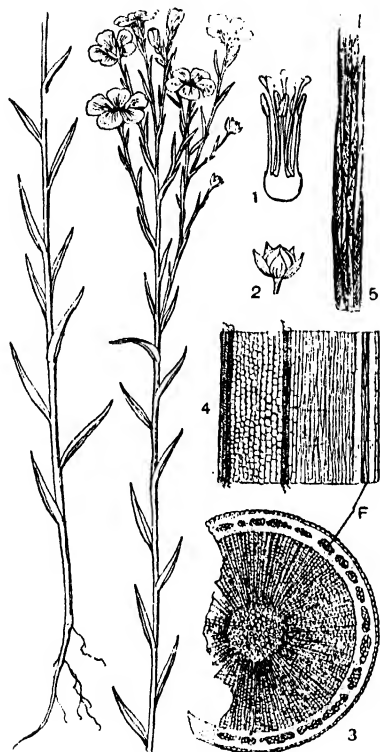
Flaubert (flô-bâr), Gustave, French novelist, was born in 1821 at Rouen, died in 1880. He received his preliminary education in his native town, afterwards going to Paris to study law; but he soon gave this up and devoted himself to literature. He first became famous in 1857 as the author of *Madame Bovary*, a realistic study of contemporary life. In 1858 he travelled in Tunisia, and four years later published the historical romance *Salammbô*, depicting the life and manners of ancient Carthage. *L'Éducation sentimentale* (1880) was a return to the style of *Madame Bovary*. The phantasmagoria *La Tentation de Saint Antoine*, and his play *Le Candidat*, appeared in 1874. In 1877 he produced *Trois Contes*, a set of three stories, one of which was *Un Cœur simple*, and was engaged upon another novel, *Bouvard et Pécuchet*, at his death. His posthumous works include: *Lettres à George Sand* (1884), *Par les champs et par les grèves* (reminiscences of a tour in Brittany in 1847), &c.—**BIBLIOGRAPHY**: E. Faguet, *Flaubert*; M. du Camp, *Souvenirs Littéraires*.

Fla'vel, John, nonconformist divine, born in Worcestershire 1627, died at Exeter 1691. He was curate at Deptford and Dartmouth, but was ejected under the Act of Uniformity, when he continued to preach privately. After the fall of the Stuarts he returned to Dartmouth. His works, among which is *Husbandry Spiritualized*, were long immensely popular.

Flavin (Lat. *flavus*, yellow), a yellow dye, the colouring matter of which is quercitrin. It is contained in quercitron bark, and is extracted

from the bark by treating first with alkali and then with acid. Flavin has much greater tinctorial power than quercitron bark and yields with aluminium and tin mordants very brilliant colours.

Flax, the common name of the plants of the genus *Linum*, nat. ord. Linacæ. It is supposed that there are nearly a hundred of the species, but the one which is cultivated specially, either



Flax

1, Stamens and pistil. 2, Fruit. 3, Cross-section of stem. 4, Longitudinal section of stem. 5, Flax fibre. F, Flax fibres in situ.

for the production of linseed or for flax fibre, is that known as *Linum Usitatissimum*. This plant grows in most of the temperate regions as well as in warm ones, rises to a height of about 3 feet, has lanceolate leaves, and bears small flowers—usually of a pale-blue colour, but occasionally white. When the plants are required for fibre-producing purposes, the seeds are sown rank, but if linseed and oil are the products desired, a smaller quantity of seed per acre is sown. The seeds obtained from plants which have been grown specially for fibre are

not so good as those where the plants are less rank in the field, and which have been grown solely for seed. When the flowers begin to droop, and the leaves turn yellowish, the harvesting of the plants is commenced. All flax plants for fibre are pulled up by the roots, tied together in small bundles, and arranged neatly in large crates. These crates, with their charge, are then submerged in specially prepared ponds or else in slowly running streams; in the latter case the crates are moored to the bank for safety. Fermentation commences almost immediately, and, after a few days—the time depending upon several conditions—the bast layer, which contains the fibres, is found to be capable of being stripped easily from the stalk. This operation of steeping is technically termed *retting*. When the stalks reach the above condition, they are removed from the crates and placed in the field in stooks to dry. Subsequently, the stalks are *rippled*, that is, the upper ends drawn between the teeth of a coarse comb, which results in the seed-bolls being separated from the stalks or stems. At other times the stalks are passed between a pair of rotating rollers so set that they break the seed-bolls without damaging the seed. From this point the two products pass to different industries. The seed may be used in this state after it has been cleaned and polished, or it may be crushed in order to extract the oil, in which case the residuc, called linseed-cake, is used as food for cattle. The stalks are taken to the breaking and scutching department. The breaker consists of a number of pairs of fluted rollers, and, as its name implies, breaks the woody part of the stalk without damaging the fibrous layer. The latter is then taken to the scutching-mill, which consists of a number of blades fixed radially to a rotating centre. A fixed board is used in conjunction with the rotating boards or blades, and about one-half of the fibrous layer at a time is passed through a slot in this fixed board and hangs between it and the rotating blades; the remaining woody or barky matter left in after breaking is literally scraped from the fibrous layer by the scutcher, so that this layer may be as clean as possible before it undergoes the first operation in a so-called spinning-mill. The flax fibre, according to quality, may then be made into *line* or *tow*; the former is the best, and is a result *inter alia* of a hackling process, while the tow is less valuable than line, and is due to a carding process. Both types are ultimately made into *sliver* form (a thin ribbon-shaped and continuous collection of fibres), and these slivers are doubled, i.e. two or more are joined, drawn, roved, and spun, by elaborate types of machines, into yarns of various thicknesses and qualities. These yarns are subsequently used in the single state as

warp and weft in the manufacture of various kinds of linen goods, e.g. sailcloth, tent duck, table, bed, and household linen generally and for many kinds of ornamented fabrics. Two or more of the above single yarns may be compounded (twisted together) to form more valuable substances for cloth-making, or they may be similarly twisted for use as threads, twine, fishing-lines, or the like, or knitted into garments or nets. The finest grades of flax, which may be used in the manufacture of lace, cambric, lawn, and similar delicate and light structures, can be drawn and spun to very fine yarns, so fine that it may require more than 100,000 yards in length to make one pound in weight. In normal times Russia is by far the greatest flax-producing country, but large quantities of superior fibre are grown in other continental countries and in Ireland, while recently increased amounts have been grown in England and Scotland.—Cf. H. R. Carter, *Flax and its Products*.

Flaxman, John, one of the most distinguished English sculptors, born at York 1755, died in London 1826. His earliest ideas on art were derived from casts in the shop of his father, who sold plaster figures, from many of which young Flaxman made drawings and models in clay. In 1770 he was admitted a student of the Royal Academy, and for some time earned a living by producing designs and models for Wedgwood the potter. He also began the series of sepulchral monuments which were ultimately his chief source of livelihood. In 1787 he went to Italy, where he remained seven years, producing some important sculpture, and winning fame by his designs in outline to illustrate Homer, Dante, Æschylus, and later (1817) Hesiod. In 1794 he returned to England, where he was diligently occupied with his professional pursuits until his death. He had been elected an associate of the Royal Academy in 1797, royal academician in 1800, and in 1810 was appointed professor of sculpture to that institution. His works are very numerous, and are to be found all over the country, a considerable number being in St. Paul's Cathedral and Westminster Abbey, a notable example being the monument of Lord Mansfield. They include public monuments in the round, memorials for churches, and classical and ideal pieces. His best works are his simple monuments in relief. A large collection of casts from the original models is preserved in University College, London.—Cf. A. Cunningham, *Lives of the most eminent British Painters, Sculptors, and Architects*.

Flax, New Zealand, a fibre obtained from a plant belonging to the ord. Liliaceæ, the *Phormium tenax*. It is indigenous in New Zealand and Norfolk Island, and grows in great tufts with sword-shaped leaves sometimes 6 feet long. The

long spike, bearing a large number of yellow flowers, rises from the centre of the leaves. The thick leathery leaves contain a large quantity of good strong fibre, which is used by the natives of New Zealand for making cloth, nets, &c. Considerable quantities of this flax (or hemp) are imported into Britain, being used for ropes, twine, &c. Cloth has also been made of it. The plant has been introduced into European culture.

Flea, a name for blood-sucking insects regarded by entomologists as constituting a sub-order of the two-winged flies (Diptera), termed Aphaniptera because the wings are inconspicuous scales. All the species more or less resemble the common flea (*Pulex irritans*). The body is laterally compressed, and the mouth-parts are modified into piercing stylets and a suctional proboscis. The flea is remarkable for its agility, leaping to a surprising distance, and its bite is very troublesome. Eleven species of flea are known to spread the germs of plague, especially one (*Xenopsylla cheopis*) that is parasitic on rats. The sand-flea (*Sarcopsylla penetrans*), chigoe, or jigger of tropical America, is a serious pest, for its eggs are deposited in the feet of human beings, causing painful swellings.

Fleabane, a name popularly given to several composite plants from their supposed power of destroying or driving away fleas, as the species of the genus *Conyza*, which were believed to have this power when suspended in a room. The common fleabane is *Pulicaria dysenterica*, found in moist sandy places in the south of England. Its smoke was supposed to expel fleas. The blue fleabane is *Erigeron acre*, common on dry banks.

Flea-beetle, the name given to different species of small springing beetles which are destructive to plants. The turnip-flea (*Altica nemorum*), whose larvæ are sometimes so destructive to young turnips, furnishes an example. It is popularly, but erroneously, called the turnip-'fly'. An allied species (*A. concinna*) is very destructive to hops.

Flèche (flâsh), La, a town in France, department of Sarthe, on the right bank of the Loir, 25 miles south-west of Le Mans. It contains a military college, occupying part of the extensive buildings of a former college belonging to the Jesuits. Pop. 10,830.

Flecknoe (flek'nô), Richard, an English poet and dramatic writer, said to have been a Roman Catholic priest, contemporary with Dryden, and chiefly memorable for having had his name gibbeted by that satirist in the title of his satire against Shadwell (*Mac Flecknoe*). He died in 1678.

Fleet Marriages, irregular marriages performed without licence by needy clergymen in the Fleet Prison, London, from about 1616 till they were suppressed by the Marriage Act of

1754. These clergymen were ready to marry any couples that came before them for a fee proportioned in amount to the circumstances of those who were married. Sometimes a dram of gin was thought sufficient; at other times the fee was rather exorbitant. Registers of these marriages were kept by the officiating parties, and a collection of these books, purchased by Government in 1821, amounted to between 200 and 300 large registers, and upwards of 1000 smaller books. These books were inadmissible as evidence in a court of justice.—Cf. J. Ashton, *The Fleet: its River, Prison, and Marriages*.

Fleet Prison, once a celebrated prison in London till it was pulled down in 1845. It stood on the east side of Farringdon Street, and on this site a prison was in existence as early as the twelfth century, which took its name from the creek or stream of the Fleet, on the bank of which it was erected. Used as a prison for religious martyrs during the reigns of Mary and Elizabeth, and for political offenders in the reign of Charles I, it became in 1641 a place of confinement for debtors, and served as such down to the period of its abolition. It was burned by Wat Tyler in 1381, at the Great Fire in 1666, and by the Gordon rioters in 1780. It was the scene of many disgraceful abuses, and was called by Pope the 'Haunt of the Muses', from the number of poets who were confined in it.

Fleetwood, a seaport and watering-place in England, in the county of Lancashire, on the Wyre, near its entrance into Lancaster Bay, 18 miles north-west of Preston. The harbour is safe and commodious, and there is a large coasting trade. Passenger steamers sail daily from Fleetwood to Belfast. Rossall School is situated close at hand. Pop. 19,448.

Flemish Language and Literature. The Flemish or Vlaemisch language is a form of Low German, differing only slightly in pronunciation and orthography from the Dutch. It is spoken by a considerable number of the inhabitants of Belgium, especially in the provinces of East Flanders, West Flanders, Antwerp, Limburg, and Brabant. A fragment of a prose translation of the *Psalms* upwards of a thousand years old is the oldest extant specimen of the Flemish. The 'father of Flemish poetry', Jakob van Maerlant, wrote several romances dealing with Merlin and the Holy Grail, *The Mirror of History*, and other works, in the thirteenth century; and a version of *Reynard the Fox* belongs to the same period. The fourteenth century was remarkable for the number of wandering poets, authors of knightly romances. The translation of the Bible, which is considered the standard for the construction and orthography of the language, was finished in 1618. The eighteenth century pro-

duced several good writers on philology, but was barren in poetic genius. The French almost annihilated the native literature, and it did not revive till the revolution of 1830, since which time it has been very vigorous. The leaders in this revival were Willems, Blommaert, Van Ryswyck, Hendrik Conscience, Van Duyse, Snelaert, Snieders, De Laet, Dedeker, David, and Bormans. Among modern Flemish writers are: Guido Gezelle, Hilda Ram, Cyril Buysse, Backelmans, Max Rooses, Pol de Mont, and Frans de Potter.—**BIBLIOGRAPHY**: Delepierre, *Sketch of the History of Flemish Literature*; P. Hanchius, *Histoire politique et littéraire du mouvement flamand*.

Flemish School of Painting. See *Painting*.

Flensburg, formerly **Flensborg**, a town in Schleswig-Holstein, at the west end of the fjord of same name, 20 miles N.N.E. of the town of Schleswig. It is now the most important town in Schleswig. There were disturbances in the town in Sep., 1919, during the Schleswig-Holstein plebiscite, taken in accordance with the terms of the Treaty of Versailles. Pop. 60,922.

Flers (flār), a town in France, department of Orne, 37 miles north-west of Alençon. It contains the remains of a fine old castle, and has manufactures of linen and bleachworks. Pop. 13,810.

Flesh, a compound substance forming a large part of an animal, consisting mainly of the muscles, with connective tissue, and the blood-vessels and nerves supplying them. It consists chiefly of fibrin, with albumen, gelatin, hematosin, fat, phosphate of sodium, phosphate of potassium, phosphate and carbonate of calcium, sulphate of potassium, and chloride of sodium. The solid part is, besides, permeated by an alkaline fluid, called flesh-juice. It has a red colour, and contains dissolved a number both of organic and inorganic substances. The organic matter consists of albumen, casein, creatine, and creatinine, inosic and several other acids; the inorganic, of alkaline sulphates, chlorides, and phosphates, with lime, iron, and magnesia.

Flesquières, a village of France, department Nord. Heavy fighting took place here during the European War. The village, taken by the British on 21st Nov., 1917, and evacuated in March, 1918, was retaken in Sep., 1918.

Fleta, a Latin commentary upon English law, said to have been written in the Fleet Prison in the reign of Edward I. It has been attributed to William de Brampton, and also to Thomas de Weyland, J. de Lovetot, and Adam de Strutton. It is impossible to determine the author, unless further evidence is discovered. Sir W. S. Gilbert gave the name Fleta to one of the faeries in his opera *Iolanthe: or the Peer and the Peri*.

Fletcher, Andrew, a Scottish political writer, the son of Sir Robert Fletcher of Saltoun, born in 1653, died in London 1716. He opposed the court in the Scottish Parliament, and had to retire to Holland. In 1685 he joined the enterprise of the Duke of Monmouth. He afterwards took refuge in Spain and in Hungary, and returned to England at the Revolution. He brought forward measures to secure the religion and liberties of the nation on the death of the queen (Anne), and carried various limitations of the prerogative, forming part of the Act of Security, rendered nugatory by the Scottish union, which he vehemently opposed.

Fletcher, Giles, brother of Phineas Fletcher and cousin to the dramatist John Fletcher, an English poet and clergyman, born 1580, died 1623. He published *Christ's Victory and Triumph over Death* in 1620.

Fletcher, John. See *Beaumont and Fletcher*.

Fletcher, Phineas, brother of Giles, born 1584, died 1650. He entered Cambridge in 1600, and was rector of Hilgay, Norfolk. Among his works are: *The Locusts, or Apollyonists*, a satire against the Jesuits; *Sicelides*, a dramatic piece; *The Purple Island*; and *Piscatory Eclogues*.

Fleur-de-lis (fleur-dè-lê'; Fr., 'flower of the lily'), in heraldry, a bearing as to the origin of

posed the Duc de Bourbon as first minister, but in 1726 he overturned the Government which he had himself set up, and from that date kept the direction of affairs in his own hands. In the same year he was made a cardinal. The internal affairs of France prospered under his administration, but his foreign policy was unfortunate.

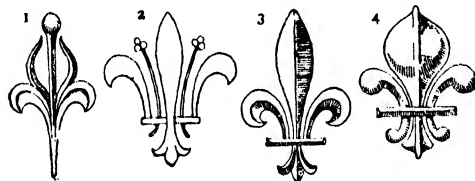
Fleury, Claude, French writer, born 1640, died 1723. He was educated in the Jesuit College at Clermont, and after beginning to practise as a lawyer resolved to take orders. In 1672 he became the tutor of the young Princes of Conti, and afterwards associated with Fénelon in the education of the young Dukes of Burgundy, Anjou, and Berri. In 1716 he became confessor to Louis XV. He had procured admission into the Academy in 1696 by several important works, among which the best known are his *Histoire du droit français*, *Mœurs des Israélites*, *Mœurs des Chrétiens*, *Institution au droit ecclésiastique*, *Histoire Ecclésiastique*.

Fliedner (fléd'ner), Theodore, D.D., German clergyman and philanthropist, born 1800, died 1864. He became pastor of Kaiserswerth in 1822, but found his life-work in prison reform; the institution of a Protestant order of deaconesses for the relief of the sick, the poor, and the fallen; and the establishment of schools and training-colleges.

Flinders, Matthew, English navigator, celebrated for his Australian discoveries, born in Lincolnshire 1774, died 1814. He went to Australia in 1795, and discovered Bass Strait in 1798. In 1801 he obtained from the British Government the command of an expedition to explore the Australian coasts, in which he spent two years. Returning home, he was taken prisoner by the French at Mauritius, and detained till 1810, after which he published his *Voyage to Terra Australis*. *Flinders Island* (off the north-east coast of Tasmania) was named after him.

Flint, Robert, Scottish theologian and philosopher, born near Dumfries in 1838, died in 1910. Educated at Glasgow University, he became minister at Aberdeen in 1859 and of Kilconquhar in 1862. In 1864 he was appointed to the chair of moral philosophy at St. Andrews University, and in 1876 to that of divinity at Edinburgh University. He was Stone lecturer at Princeton University in 1880, and Croall lecturer at Edinburgh in 1887-8. His works include: *Christ's Kingdom upon Earth* (1865); *Philosophy of History in Europe* (1874); *Theism and Anti-theistic Theories* (1877); and *On Theological, Biblical, and other Subjects* (1905).

Flint, or **Flintshire**, a maritime county in North Wales, consisting of two separate portions, a larger and smaller, the latter being distant 6 miles S.E. from the main portion, and separated from it by Denbighshire; total area, 163,707



Fleur-de-lis

1, Early form. 2, Middle Ages. 3, Renaissance.
4, Lou's XIV.

which there is much dispute, some authorities maintaining that it represents the lily, others that it represents the head of a lance or some such warlike weapon. The fleur-de-lis was for long the distinctive bearing of the Kings of France.

Fleurus (fleur-rûs), a town of Belgium, province of Hainaut, 7 miles north-east of Charleroi. In the vicinity, in 1690, the French under Marshal Luxembourg defeated the Germans under Prince Waldeck; and in 1794 the French republican forces under Marshal Jourdan defeated the Austrian army. Pop. 6090.

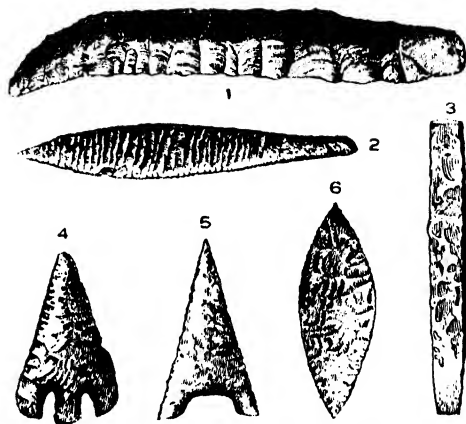
Fleury (fleur-rê), André Hercule de, cardinal and Prime Minister of Louis XV, was born in 1653, died in 1743. In 1698 Louis XIV gave him the bishopric of Fréjus, and shortly before his death appointed him instructor to Louis XV. After the death of the regent in 1723 he pro-

acres, of which three-fourths is under crops or in pasture. A range of hills of moderate elevation intersects the county lengthways south-west to north-east. There are numerous well-watered and fertile valleys, including a portion of the celebrated Vale of Clwyd. The county is rich in minerals, particularly lead, the mines of which are productive. Coal also abounds, and copper is obtained in considerable quantities. Flint returns one member to the House of Commons. Pop. 106,466.—*Flint*, county town, a municipal borough and seaport, is situated on the estuary of the Dee, 13 miles s.w. of Liverpool. In the vicinity are extensive alkali-works and several lead- and coal-mines. There are also large copper-works. The shipping trade of the port is small. A little north-east of the town, on the shore of the estuary, stands the ancient castle of Flint, commenced by Henry II and completed by Edward I. It was the prison of Richard II, and has remained in ruins since 1667. Formerly a parliamentary borough, Flint was disfranchised in 1918. Pop. 6302.

Flint, minutely crystalline silica of a bluish-grey or greyish-black colour, weathering white or yellowish-brown. It usually occurs in nodules or rounded lumps as a chemical replacement of limestone. Its surface is generally uneven, and covered with a whitish rind or crust, the result of weathering or of the action of water percolating through the rocks. It is very hard, strikes fire with steel, and is used as an ingredient in glass and in all fine pottery ware. The fracture of flint is perfectly conchoidal; though very hard, it breaks easily in every direction, and affords very sharp-edged splintery fragments, formerly made into arrow-heads, &c. (See *Flint Implements*.) In England, flint is most typically seen in the Upper Cretaceous chalk, in which it is formed as a series of concretions arranged in zones parallel with the stratification. The silica in sponges and in other marine animals which lived on the sea-floor while the chalk was being deposited no doubt furnished the silica thus concentrated along certain zones.

Flint-glass, a species of glass, so called because pulverized flints were originally employed in its manufacture. It is extensively used for domestic purposes. Its dispersive power in regard to light renders it invaluable in the manufacture of the object-glasses of telescopes and microscopes, as by combining a concave lens of flint-glass with one or two convex lenses of crown-glass, which possesses a much lower dispersive power, a compound lens is formed in which the prismatic colours arising from simple refraction are destroyed, and the lens rendered achromatic. Quartz and fine sand are now substituted for flint in the manufacture of this glass. See *Glass*.

Flint Implements and Weapons. According to those who believe that Eoliths were shaped by man, flint working dates back to the Second Interglacial epoch, or an even earlier period. The Lower Palaeolithic Age flints have been classified as Chellean, Acheulian, and Mousterian, and were worked by Neanderthal man. A new technique was introduced into Europe from North Africa by Cro-Magnon man (about 20,000 B.C.) at the beginning of the Upper Palaeolithic period, which has been divided into the three cultural stages, Aurignacian, Solutrean, and Magdalenian. The Solutrean technique was extremely fine, distinctive forms being the leaf-shaped flint lances



Neolithic Flint Implements and Weapons

1, Knife. 2, Knife or dagger. 3, Chisel. 4, 5, and 6, Arrow-heads.

From specimens in the British Museum and the Museum of Practical Geology.

and delicately worked flint gimlets. In ancient Egypt the Solutrean technique reached a high pitch of development. No finer flint artifacts than Solutrean were ever produced in ancient times. The Magdalenian flints are of poorer quality and workmanship than even the Earlier Aurignacian. During this cultural stage in Europe bone and horn implements and weapons were more in use than those of flint. The transition period between the Palaeolithic and Neolithic Ages is divided into Azilian, Tardenoisian, and Maglemosian—contemporary cultures. Tardenoisian flints were chiefly microliths, or 'pigmy flints' of geometric forms. They are widely distributed, being found on the North African coast, in Central and Western Europe and the British Isles, and as far eastward in Asia as India. Azilian is Iberian, and Maglemosian is Nordic. The Neolithic technique was begun by giving an edge to flaked flint axes by polishing

on a grinding-stone. Sir John Lubbock (afterwards Lord Avebury) was the first to apply to the cultural Ages the terms Palæolithic (Old Stone), during which flint was flaked, and Neolithic (New Stone), during which it was polished. Flint chipping, however, continued throughout the Neolithic Age. Some backward peoples are still producing flint artifacts. Flint knives are used for ceremonial purposes by other peoples, including the Jews, who circumcise with a Solutrean blade. The earliest use of flint for religious purposes has been traced back to Solutrean times, when leaf-shaped lances, too delicate for use, were stained red and deposited, possibly as votive offerings, in quantities. One of the earliest representations of Hathor, the Egyptian cow-goddess, is in flint—a flint cow. The original thunder-bolts or hammers of gods like Zeus (Jupiter), Thor, and Indra were of flint. In the Far East, as in Europe, flint artifacts are supposed to be thunder-bolts, rings, axes, or arrows flung by gods or fairies and elves. Flint arrow-heads, &c., were worn as charms after the introduction of metal working. Weapons were supposed to be inhabited by spirits and were worshipped. In ancient Egypt the axe (*neter*) was a symbol of divinity. The sacred axe of Crete was an important religious symbol. It was no doubt because weapons were anciently sacred that so much lore gathered round flint arrow-heads, stone axes, &c., after these went out of use.—BIBLIOGRAPHY: Lord Avebury, *Prehistoric Times*; Osborn, *Men of the Old Stone Age*; W. J. Sollas, *Ancient Hunters*; J. Reid Moir, *Pre-Palæolithic Man*.

Flint-lock, a musket-lock in which fire is produced by a flint striking on the steel pan. Since the invention of the percussion lock by Rev. Alexander Forsyth (adopted about 1836) flint-locks have become obsolete.

Floating Batteries, batteries erected either on simple rafts or on hulls of ships, for the defence of a coast or for the bombardment of an enemy's ports. They were used notably at the siege of Gibraltar (1779–83) and during the Crimean War (1854).

Floating Island, an island formed in a lake or other inland water, consisting generally of a mass of earth held together by interlacing roots. Sometimes such islands are large enough to serve as pasture grounds. Such islands are found in many lakes of England, France, and Prussia, and are common in the White Nile. Artificial floating islands have been formed by placing lake mud on rafts of wicker-work covered with reeds.

Floatstone, a porous variety of opal of a spongy texture, whitish-grey in colour, so light as to float in water. It frequently contains a nucleus of common flint.

Flobecq (flō'bek), a town of Belgium, province of Hainaut, 20 miles N.E. of Tournai. Pop. 4070.

Flocculation, the process by which extremely fine particles of mineral matter, &c., aggregate into large lumps. The tendency of material of the nature of mud (that is, materials in which the particles average less than one-hundredth of a millimetre in diameter) to flocculate is of considerable importance in flotation methods of concentrating minerals.

Flocks, originally a term given to the accumulated fibres which become detached from woollen fabrics during the milling process, and which during the continued operation are rolled into irregularly shaped small groups. When the operation of fulling or milling is completed, the soap solution and the flocks are caused to enter a rectangular vessel with a perforated bottom, so that the flocks may be arrested while the soap solution passes through. The flocks are then removed from the vessel and dried, while the solution is collected and the oil and other substances separated. Flocks are used extensively as a substitute for hair in upholstery and in mattresses, and are now made specially for this and similar purposes; they are also used instead of feathers or down for stuffing beddings, bolsters, and pillows.

Flodden, a village of England, in Northumberland, about 5 miles S.E. of Coldstream. Near it was fought the celebrated battle in which James IV of Scotland was defeated by the Earl of Surrey (9th Sept., 1513). The loss of the Scots was from 8000 to 10,000 men, including the king, the Archbishop of St. Andrews, and a large number of the nobles; that of the English from 6000 to 7000. At the beginning of the battle the armies mustered respectively 30,000 and 32,000 men. The English victory was so near a defeat that Surrey was unable to prosecute the war with any vigour. See Sir Walter Scott's poem *Marmion*.

Flogging, the infliction of stripes or blows with a whip, lash, or scourge, especially as a judicial punishment. In Britain it long existed as a punishment in the army and navy; but it was totally abolished in the former in 1881, and in the latter it was abolished in 1906. It was made a punishment for certain violent crimes, such as garroting, in 1863; for juvenile offenders in 1847 and 1850; and for certain offences of males against morality under the Criminal Law Amendment Act, 1912. The punishment of the knout in Russia before the revolution of 1917, and of the bastinado in the East, are severe forms of this punishment.

Flood, Henry, Irish orator and politician, born near Kilkenny 1732, died 1791. He entered the Irish Parliament in 1759, was Privy

Councillor for Great Britain as well as for Ireland in 1775, and Vice-Treasurer for Ireland from 1775 to 1781. In 1783 he had a personal dispute in the House with Grattan, when a remarkable display of the power of invective was made on both sides. He afterwards became a member of the British Parliament. His speeches and some poetical pieces were published in 1787.

Floor-cloth, a term which is usually applied to soft woollen fabrics used for washing floors and the like. It is essentially a fabric which is capable of absorbing a comparatively large amount of water, and is made from thick soft-spun woollen yarns in a coarse *sett*. The term floor-cloth was formerly applied to different kinds of fabrics, other than carpets and rugs, which were used for covering kitchen floors and other places where there is much traffic. A considerable quantity has been made for years from coir fibre yarns (coco-nut fibre) and similar material, and used for the aisles of churches, kitchen, office, and similar floors. Its open nature had obvious defects in regard to methods of cleaning, and this led to the introduction of fabrics coated with impervious substances, which

and laid on a fibrous foundation. This method of manufacture probably led to the extensive linoleum trade which now supplies in the various grades the bulk of modern hard floor coverings.

Floors and Floor-space. Floors are constructed with wooden joists, rolled-steel joists, solid reinforced concrete, or hollow bricks with rolled-steel joists. For the purpose of calculating the loads on foundations, and other constructions carrying loads in buildings, the superimposed loads are taken as equivalent to the following dead load.

	Pounds per square foot of floor area.
Domestic purposes	70
Hospitals	84
Counting-houses and offices	100
Public concert-rooms, retail shops, and workshops	112
Ballrooms and similar floors subject to vibration	150
Book-stores in libraries and floors of warehouses	224

TABLE OF WOOD GIRDERS, BINDERS, AND JOISTS IN BALTIMORE FIR

Length of bearing in feet.	Girders 10 feet apart.		Binders 4 feet to 6 feet apart.		Joists 1 foot apart.		Ceiling joists 1 foot apart.	
	Depth in inches.	Breadth in inches.	Depth in inches.	Breadth in inches.	Depth in inches.	Breadth in inches.	Depth in inches.	Breadth in inches.
6			6	4	6	2	4	2
8			7	4½	7	2½	4	2
10	9	6	8	5	7½	2½	5	2
12	10	8	9	6	8	2½	6	2½
14	11	9	9	6	9	3		
16	12	10	11	6½	11	3		
18	12	11	12	7	12	3½		

not only fulfilled the function of an attractive floor covering, but were also easily washed, mopped, or otherwise cleaned. The fabric was, indeed, very similar to, but heavier than, oil-cloth or American cloth, which is used for covering tables; the foundation was made from hemp and flax-tow yarns, and the surface appeared in solid colours, but was often decorated by designs in various colours. Floor covering has also been made from a mixture of different kinds of oils with substances which, when combined, set hard so as to yield the well-known linoleum-like article. The floor-cloth known as *kamptulicon* is made from ground cork, india-rubber, and other substances, rolled into sheets between heavy steam-heated calender rollers, or else prepared

Trimmer joists should be 1 inch thicker than ordinary joists. In floors of wide span, if there is a ceiling beneath, the deflection should not exceed $\frac{1}{10}$ inch per foot of span. Hoop iron 2 inch by $\frac{3}{8}$ inch tarred and sanded is a good substitute for joists to be notched over in lieu of a fir wall plate, which is liable to decay. The ends of timbers built in walls should have an air-space round them, and the floor should also be ventilated. Floor joists of long span can be stiffened by herring-bone strutting 2 inches by 2 inches, about 5 feet apart the full depth of the joists, or solid bridging 1½ inches thick with a $\frac{3}{8}$ -inch round iron tie through the neutral axis of the joists close to the solid bridging. Solid floors of reinforced concrete should not be made

of coke breeze on account of its liability to expand. As a general rule the span for rolled-steel joists carrying a distributed load should not exceed 24 times the depth of the joist. Reinforced hollow block floors can be made with a depth of 5 inches and a span of 10 feet to carry 112 lb. per foot super. The best floor-boards come from the White Sea ports, the second quality from Canada and the Baltic. For hard wear maple flooring is the best; it is generally prepared grooved and tongued and holed for nails through the tongues. Pitch pine, oak, and teak are used for floor-boards. In hospitals antiseptic floors are made of teak and terrazzo. Solid floors are finished with wood blocks which are fixed in mastic, and sometimes dowelled. Linoleum and rubber are used in sheets fixed with cold glue as a finish to concrete floors. Jointless floors are made of a mixture of sawdust and cement. Many of them contain also magnesite, which destroys any iron it comes in contact with, and special precautions should be taken to protect the metal.

Floor-space.—*Hospitals*, from 90 feet to 160 feet super per patient; *surgical wards*, 150 feet to 200 feet super; *workhouse infirmaries*, 70 feet super per inmate, special wards 160 feet super; *elementary schools*, classrooms 10 feet super, assembly hall 6 feet super; *secondary schools*, 15 feet to 18 feet super. Lodging-houses and factories are regulated by cubic capacity on account of the varying height of the stories. Offices, if they are not considered to be workshops, come under the sections of the Public Health Act which deal with overcrowding, and are reckoned by cubic capacity and not floor-space.

Flora, the Roman goddess of flowers and spring, whose worship was established at Rome in the earliest times. Her festival, the Floralia, was celebrated from 28th April to 3rd May with much licentiousness.

Flora, in botany, signifies the plants of a region collectively, as *fauna* signifies the animals.

Floréal (flō-rā-äl; month of flowers), the eighth month in the calendar of the French Revolution. It began 20th April, and ended 19th May.

Florence (It. *Firenze*; in O.It. and in poetry, *Fiorenza*; ancient *Florentia Tuscorum*), a celebrated city of Italy, capital of a province of the same name, 143 miles N.W. of Rome, and 50 miles E.N.E. of Leghorn. The city is surrounded by hills, and is beautifully situated on both banks of the Arno, the greater part, however, lying on the right bank. The river is spanned by four stone and two iron bridges: the Ponte alle Grazie, constructed 1235, restored 1835; the Ponte Vecchio (the 'Old' Bridge),

said to date from the Roman period, reconstructed in 1362, and still retaining its old form, with its three arches supporting a roadway with goldsmiths' shops on either side, and above, a covered passage connecting the Pitti Palace and the Uffizi; the Ponte Santa Trinità, erected soon after 1567, adorned with statues, and remarkable for the symmetry of its arches; the Ponte alla Carruja, 1218, restored 1337, and again in 1559; and two iron suspension bridges at either end of the city. On either side of the Arno is a spacious quay called the Lung' Arno, a favourite promenade. The private dwellings are mostly handsome, and the palaces, of which there are many, are noble and impressive structures. The city contains numerous piazzas or squares, the most important being the Piazza della Signoria, surrounded by important buildings, and adorned with a marble fountain, and a bronze equestrian statue of Cosmo I. In this piazza is situated the Palazzo Vecchio, originally the seat of the Government of the republic, and subsequently the residence of Cosmo I; also the Loggia dei Lanzi, a fine open arcade containing numerous well-known groups of statuary. The most remarkable building in Florence is the Duomo, or cathedral of Sta Maria del Fiore, erected between 1298 and 1474, but its façade not completed till 1887, and the porches, which are adorned with statues and reliefs, only in 1903. One great feature is Brunelleschi's magnificent dome which served Michael Angelo as a model for St. Peter's at Rome. The cathedral is situated in a spacious square, nearly in the centre of the city. Close by are the Campanile or bell-tower designed by Giotto, and the Baptistery of San Giovanni, the latter having three bronze gates with figures in relief, one of them by Andrea Pisano, and the other two by Ghiberti, celebrated as among the most beautiful works of the kind extant. The church of S. Croce contains the tombs of many eminent Tuscans, among them Michael Angelo, Galileo, Machiavelli, and Alfieri, besides much fine sculpture and fresco-work; while in the Piazza outside stands the Dante memorial by Pazzi. The chief art collection is the Galleria degli Uffizi, which contains specimens of painting and statuary by the greatest masters. In statuary, among numerous antiques may be specified the *Venus de' Medici*, the *Apollino*, the *Knife-grinder*, the *Dancing Faun*, the *Wrestlers*, and the group of *Niobe and her Children*; while in painting there are works by Leonardo da Vinci, Botticelli, Ghirlandajo, Michael Angelo, Raphael, Titian, Fra Angelico, Fra Bartolomeo, Andrea del Sarto, Correggio, Guido, &c. Other important art collections are preserved in the churches and palaces, one of the principal being the paintings in the Pitti Palace. The building formerly known as the *Bargueo*,

erected about 1250 for the chief magistrate of the republic (the Podestà), and subsequently used as a prison, has been restored, and is now a national museum, illustrative of the history of Italian culture and art in mediæval and modern times. The Laurentian or Medicean Library contains upwards of 9000 ancient MSS. The Magliabecchian Library, now united with that from the Pitti Palace to form the National Library, is the great repository of printed books. The charitable institutions are numerous and important. Schools and kindred institutions are also numerous. The manufactures embrace woollens, silks, straw-hats, porcelain, mosaics, and numerous objects in the fine arts.

History.—Florence was probably founded by the Romans in the second century B.C., and early attained considerable prosperity. During the Dark Ages it was frequently devastated, but it revived about the beginning of the eleventh century, at which time the Florentines became extensive European traders. Their silk and woollen fabrics excelled, and their skill as workers in gold and jewels was unsurpassed. About this time Florence took an active part in the feud which broke out between the Guelphs and Ghibellines, the town generally supporting the former against the Imperial party. In 1283 a species of republic was constituted; but about the year 1300 the party struggles again burst forth between the same rival families under the new names of the *Whites* and the *Blacks*, in which the Blacks (the Guelphs) were eventually victorious, and the Whites, among whom was the poet Dante, banished. In the course of these troubles a family of merchants named the Medici rose to great influence in Florentine politics. One of them, Cosmo, born 1389, was the founder of the political greatness of his house. His grandson, Lorenzo, surnamed *Il Magnifico*, as a statesman, scholar, and patron of art and literature, attained the highest celebrity. Under him Florence, which, though calling itself a republic, was in reality ruled by him, rose to a great pitch of opulence and power, and notwithstanding the hostility of the Pope he exercised a great influence throughout Italy. On the fall of the republic in the sixteenth century a member of a lateral branch of the Medici, the line of Cosmo having become extinct, was created Duke of Florence by Charles V. The ducal dynasty of Medici continued to rule till the year 1737, when, becoming extinct, they were succeeded by Francis of Lorraine, afterwards Emperor of Germany. From this period the history of Florence merges into that of Tuscany until its amalgamation with the Kingdom of Italy. From 1865 till 1871 it held the dignity of capital of the new Kingdom of Italy, the seat of the Government being transferred

to it from Turin. Amongst the illustrious men it has produced are Dante, Petrarch, Boccaccio, Guicciardini, Lorenzo de' Medici, Galileo, Michael Angelo, Leonardo da Vinci, Benvenuto Cellini, Andrea del Sarto, Amerigo Vespucci, Macchiavelli, and others. Pop. (including suburbs), 242,147.—The province has an area of about 2262 English sq. miles. The surface is beautifully diversified by mountains, valleys, and plains. The climate is generally mild and healthy, and the soil very fertile. Pop. 1,028,740. —BIBLIOGRAPHY: C. Yriarte, *Florence*; Ruskin, *Mornings in Florence*; E. Hutton, *Literary Landmarks of Florence*; F. T. Perrens, *Histoire de Florence* (9 vols.); E. V. Lucas, *A Wanderer in Florence*; J. W. Brown, *Florence, Past and Present*.

Florence, Council of, along with that of Ferrara, a continuation of the Council of Basel. At Florence its sessions continued at intervals from 1439 to 1442. Its object was a reunion of the Eastern and Western Churches; but the seeming agreement come to was soon after repudiated by a council at Constantinople.

Florentine Work, a kind of mosaic work, consisting of precious stones and pieces of white and coloured marble, which has long been produced in Florence. It is applied to jewellery, and used for table tops.

Flo'res, or Floris, an island of the Indian Archipelago, in the Sunda group which extends east from Java. It is about 230 miles long and from 15 to 35 miles wide, and has a mountainous surface, with several volcanic peaks. The natives are tall and robust frizzly-haired savages, belonging to the dark Papuan race. The island is under Dutch supremacy. Sundulwood, bees'-wax, and horses are exported. The passage between the east end of the island and those of Solor and Adenara is called Flores Strait; and the part of the Pacific north of the Flores chain and south of Celebes is called the Flores Sea.

Flo'res, the most westerly island of the Azores, about 30 miles long by 9 miles broad, with a hilly surface. The chief products are wheat, pulse, and poultry, and great numbers of small cattle are reared. Flores was the station of the English fleet before the fight between Sir Richard Grenville in the *Revenge* and fifty-three Spanish vessels in 1591. Pop. about 10,850.

Flor'et, a single small flower in a compact inflorescence, as in the Compositæ, Dipsacæ, and grasses. See *Illustration* on p. 66.

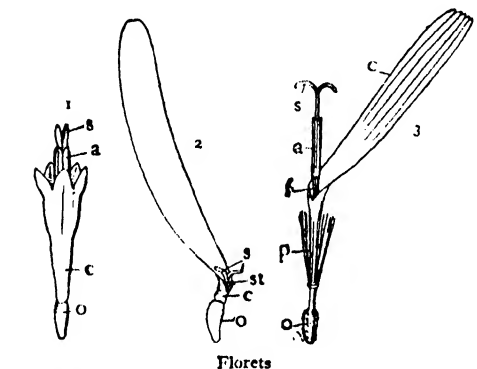
Florian, Jean Pierre Claris de, French writer, born 1755, died 1794. He was patronized by Voltaire, and gained fame as a writer of fables, pastorals, romances, and comedies. He was imprisoned during the Revolution, but the fall of Robespierre saved him from the guillotine.

His romances *Galatée*, *Estelle*, *Gonzalve de Cordoue*, *Numa Pompilius*, his fables, and translation of *Don Quixote* are his best works.

Florian, St., the patron saint of Poland, born about A.D. 190, died by drowning during the Diocletian persecution, 230. He is represented as pouring out flames from a vessel, and his protection is sought against fire.

Florianopolis. See *Desterro*.

Florida, one of the United States, forming the south-eastern extremity of the country, and having the Gulf of Mexico on the south and west, and the Atlantic on the east. It consists partly of a peninsula stretching south for about 400 miles, partly of a long, narrow strip of land running along the Gulf of Mexico to a distance of



1, Disc Floret of Daisy. 2, Ray Floret of Daisy. 3, Floret of Dandelion; a, ovary; p, pappus; c, corolla; a, anther tube; st, style; s, stigma; f, filaments.

350 miles from the Atlantic coast-line. The peninsula is about 90 miles in width, and contains about four-fifths of the total area, which is 58,000 sq. miles. The surface is in general level, rising little above the sea, especially in the southern parts, where it is almost a continuous swamp or marsh. The northern portion is more broken and elevated, but the whole coast is flat. The principal river is the St. John's, flowing northwards through peninsular Florida to the Atlantic. Its tributary, the Ocklawaha, has its course so flat that for a long distance it spreads out into the forest for half a mile or more on either side, so that nothing is seen but trees and water. The Appalachicola and Suwanee flow into the Gulf of Mexico. There are many lakes throughout the peninsula, the largest being Okeechobee (area 650 sq. miles). Numerous islands are scattered along the south and west coasts, the most remarkable of which is a group, or rather a long chain, called the Florida Keys at the southern extremity of Florida. The most important of these is Key West, containing the city and naval station of

same name. The state produces tropical plants and fruits in great perfection, especially oranges, lemons, limes, shaddock, &c. The planting of orange groves is being carried on extensively, and oranges are now a speciality of Florida. Tobacco, cotton, sugar, maize, potatoes, rice, and oats are among the other productions. The forests form an important source of wealth. The minerals are unimportant. The wild animals comprise panthers, cougars, wolves, bears, foxes, raccoons, opossums, deer, &c. Birds are extremely numerous and various. The coasts, rivers, and lakes swarm with fish; tortoises and turtles also abound. The swamps and other inland waters are infested with alligators. Snakes are numerous, but most of them are harmless. The climate in general is excellent, and the state is much frequented as a winter health resort for invalids, many large and modern hotels having been built for the accommodation of visitors. Florida, long in a backward condition, has made great advances in prosperity, being now well supplied with means of communication, and towns and villages rapidly springing up. Tallahassee is the capital and seat of government, but the largest towns are Jacksonville (pop. 91,558), Tampa (pop. 51,608), and Pensacola (pop. 31,035); St. Augustine is the oldest town in the United States. Florida was first explored in 1512 and 1516 by Ponce de Leon, a Spanish adventurer. It was ceded to Great Britain by Spain in 1763 in exchange for Cuba; reacquired by the Spaniards in 1781, and confirmed to them at the peace of 1783. It was ceded to the United States in 1821, and organized as a territory in 1822. A long series of conflicts with the Seminole Indians retarded its prosperity. In 1845 it was admitted into the Union. In 1861 it seceded from the Union, to which it was not readmitted till 1868. Pop. in 1910, 752,619; estimated pop. in 1920, 908,471.—BIBLIOGRAPHY: S. Lanier, *Florida: its Scenery, Climate, and History*; W. W. Davis, *The Civil War and Reconstruction in Florida*.

Floridææ. See *Red Algæ*.

Florid Gothic, that highly enriched variety of Gothic architecture which prevailed in England in the fifteenth and at the beginning of the sixteenth century; often called the *Tudor style*, as it flourished chiefly during the Tudor era.

Florin, a name given to different coins of gold or silver of different values, and to moneys of account, in different countries. The coin was first struck in Florence in the thirteenth century. The English florin is 2s. or one-tenth of a pound sterling; the Austrian *gulden* or florin and the *guilder* or florin of Holland are each 1s. 8d. A gold florin, value 6s., was used in England in the reign of Edward III.

Florina, a town of Macedonia, in Greece, formerly belonging to Turkey. It was acquired

by Greece as a result of the Balkan Wars 1912-3. During the European War it was captured by the French in April, 1916, and again in Sep., 1916.

Florinians, a sect of Gnostics of the second century, so called from *Florus*, a Roman priest who was excommunicated by Pope Eleutherius in A.D. 176.

Florio, John, lexicographer and translator, born in London of Italian parents in 1553, died 1625. He taught French and Italian in Oxford University. He was appointed by James I teacher of languages to the queen and Prince Henry. His chief works are his *Italian and English Dictionary*, *The World of Words*, and his translation of Montaigne. Shakespeare is said by Warburton to have ridiculed him in the character of Holofernes in *Love's Labour's Lost*, but this is probably not true.

Floris, Frans, a Flemish painter, whose family name was De Vriendt, born at Antwerp in 1520, died there 1570. After a visit to Italy, he moulded his style on the antique and on the Italian Renaissance masters, and acquired the title of the 'Flemish Raphael'. At Antwerp he established a school for painters, which produced many eminent artists. His chief works are: *The Fall of the Rebel Angels*, in the Louvre; *The Last Judgment*, in the church of Notre Dame, Brussels; and *The Assumption*, in Antwerp Cathedral. Other works are to be met with in Flanders, Holland, Spain, Paris, Vienna, and Dresden.

Florus, Annæus, a Roman historian, was probably a native of Spain or Gaul. He is variously styled in the MSS.: in some *L. Annæus Florus*, in others *L. Julius Florus*, in others *L. Annæus Seneca*, and in one simply *L. Annæus*. He lived in the beginning of the second century after Christ, and wrote an epitome of Roman history from the foundation of the city to the first time of closing the temple of Janus, in the reign of Augustus (*Epitome de T. Livio Bellorum omnium annorum DCC Libri duo*).

Floss-silk, the portions of unravelled silk broken off in reeling the silk from the cocoons, carded and spun into a soft coarse yarn, and used for common fabrics or embroidery.

Flotation of Minerals, a process of mineral concentration in which the valuable portion of the ore is caused to float and thus separate from the worthless mineral portion or gangue. The method involved is thus exactly opposite to that commonly used in water concentration, in which advantage is taken of differences in specific gravities, the heavier portions sinking, and the lighter portions being washed away. The principles on which the various flotation processes are based are very complex, the most important being surface tension, wettability, adhesion, adsorption, viscosity, and flocculation,

although colloidal conditions and electrostatic forces may play a part of minor importance. Surface tension is the contractile force at the surface of a liquid, whereby resistance is offered to rupture. This is due to the fact that the molecules at the surface of a liquid have a greater coherence than the molecules within the liquid, and therefore the surface acts as if it were an elastic film. In flotation processes, this phenomenon is closely associated with the wettability of a solid by a liquid, and particles which are not easily wetted tend to float, whilst particles which are easily wetted tend to sink. As an example, it may be mentioned that if a small needle be carefully placed on the surface of water it will float, whereas a piece of glass of the same size, though lighter, will sink. A thin film of oil will assist the needle to float, and may cause the glass also to float, by reducing the ease with which it is wetted with water. If the needle be above a certain size, it will not float because the force of gravity overcomes the force of surface tension. In mineral separation, it is found that sulphides of the metals, for example copper pyrites, galena, zinc blende, &c., are not easily wetted and thus tend to float, whereas the gangue minerals such as silica, barites, oxide of iron, &c., are easily wetted and tend to sink. A second action which has to be taken into account is connected with the behaviour of oil. On being mixed with water, oil rises to the surface owing to its lower specific gravity and insolubility in water: it also shows a preference for certain classes of mineral sulphides such as those mentioned above, so that it attaches itself readily to them, while passing the particles of gangue, which are quickly wetted by water, and sink. This property of oil was the basis of a patent, taken out in 1898, for a process in which the ore was pulverized and mixed with water, to which oil was afterwards added. The oil, rising to the surface, carried the valuable sulphide particles with it, leaving the gangue minerals behind in the water. It was found in actual practice that the oil carried up more than its theoretical load of sulphides, and the reason for this was afterwards realized to be the effect of air which was present in the ore pulp and water. In the early methods, 3 tons of oil were used for 1 ton of ore, but in the recent modifications less than 1 lb. of oil is used per ton of ore treated. In carrying out the processes, it is essential that the material be in a very fine state of division, and they are particularly suitable for the treatment of slimed material. In the modification known as film flotation, the correct quantity of oil, such as pine oil, is added to the slime, thus making a mixture of sulphide minerals, siliceous and earthy minerals, oil, and water, which is brought gently

to the surface of still water, in a direction forming an acute angle with the surface of the water. The gangue, which has a greater adhesive preference for the water than for the oil, sinks, whilst the valuable sulphides have a greater adhesive preference for the oil, and float. In froth flotation processes, an acid or alkali is added to the slime together with the oil, and gas bubbles are caused to form by agitation or some other suitable means; a froth is thus formed which carries the valuable mineral particles to the surface, where they can be separated. By suitable adjustment of conditions, the bubbles are found to persist long enough to carry the mineral to the surface for efficient separation. Very large quantities of ores, &c., amounting to millions of tons per annum, are treated by these methods for the recovery of copper, lead, zinc, and other minerals, including certain quantities of the precious metals.

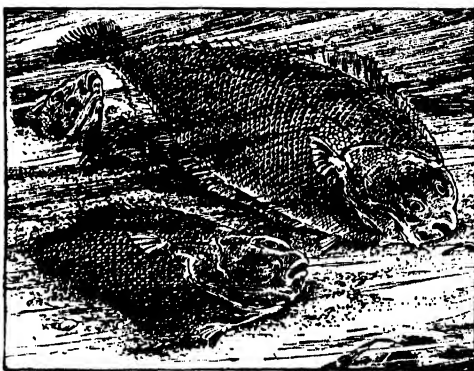
Flotow (flō'tō), Friedrich Adolphus von, German musical composer, born 1812, died 1883. He studied music in Paris, but his earlier operas did not find favour with the Parisian opera-house directors, so he had to content himself with performances in the aristocratic private theatres. At length the *Naufrage de la Méduse* was successfully produced at the Renaissance Theatre in 1839. This was followed by *L'Esclave de Camoëns* (1843), and *L'Âme en Peine* (1846), performed in London as *Leoline*. *Alessandro Stradella* was first performed at Hamburg in 1844, and his most successful work, *Martha*, at Vienna in 1847. Among his other works are: *Indra* (1853), *La Veuve Grapin* (1859), *L'Ombre* (1869), and *L'Enchanteresse* (1878). He was director of the court theatre at Schwerin from 1855 to 1869; the last years of his life were chiefly spent at Vienna.

Flotsam, Jetsam, and Ligan, in law. *Flotsam*, or *floatsam*, is derelict or shipwrecked goods floating on the sea; *jetsam*, goods thrown overboard which sink and remain under water; and *ligan*, goods sunk with a wreck, or attached to a buoy as a mark of ownership. When found, such goods may be returned to the owner if he appear; if not, they are the property of the Crown.

Flounder, one of the flat-fishes, family Pleuronectidæ, genus *Pleuronectes*, the common flounder being the *Pleuronectes flesus*. It is one of the most common of the flat-fishes, and is found in the sea and estuaries all round the British coast. Flounders, indeed, have been successfully transferred to freshwater ponds. They feed upon crustacea, worms, and small fishes, and are much used as food. An allied species is native to the Mediterranean.

Flour, the edible part of wheat, or any other

grain, reduced to powder, and separated from the bran and the other coarser parts by some process of sifting. The use of hand-mills for grinding the grain dates back to the earliest times, and was still common in some parts of this country even in the nineteenth century (see *Quern*), though grinding by means of large mill-stones driven by water-power or otherwise had long been in use. The modern flour-mill is a very elaborate structure. Chilled-iron or steel rollers have taken the place of the old mill-stones, and all the processes connected with the cleaning, grinding, separating, sifting, &c., are accomplished automatically, so that the grain is not touched by hand from the time it enters the receiving-bin till it finally emerges as the



Common Flounders (*Pleuronectes flesus*)

finished flour. Briefly, the process is as follows: The wheat is received into a bin, and then passes into a 'separator', where by means of vibrating screens and a current of air the light rubbish is separated and carried away. The grain is further cleaned and polished by means of brushes and a revolving cylinder, after which it is ready for the process of separating the 'berry' from the husk or bran. This is effected by passing the wheat through grooved rollers, the grooves being cut at an angle, which strip off the bran but only lightly crush the flour. This unfinished product is known as 'semolina' or 'middlings'. The same operation is repeated several times until all the bran is stripped and sifted away, and the 'middlings' are then subjected to several processes of alternate crushing and sifting, until the flour is finally brought to a pure and finished state. The bran has meanwhile been collected, its chief use being for feeding cattle. The best kind of flour is not that which emerges as the result of the first grinding, but that ground from the purified semolina, known as 'patent' flour. Hence the object of the modern 'high-grinding' system is to make as

little flour and as much semolina as possible from the first grinding process, whereas under the old 'low-grinding' system the aim was to produce as much flour as possible from one grinding. In consequence of this the hard grain nowadays makes the best flour, whereas formerly it was the soft grain that was in chief demand; and this is one of the reasons why we import such vast quantities of wheat from America, British wheat being comparatively soft. Different kinds of flour are made according to the different purposes to which they are to be put, and are produced not only by varying the degree of grinding to which the grain is subjected, but also by using different kinds of wheat, that of each country having its own peculiar characteristics. Various kinds of wheat are often blended by the miller to serve different purposes (see *Bread*). There are big flour-mills at London, Liverpool, Bristol, Leeds, Hull, Glasgow, Edinburgh, Leith, &c., chiefly grinding imported wheat.

As Great Britain has now the wheat supplies of the world to draw upon, the imports of foreign wheat are very great, and British millers have no lack of raw material, but a great amount of wheat-meal and flour is also imported annually. Thus in 1918 and 1919 we imported wheat-meal and flour to the value of £35,683,000 and £25,729,000 respectively. The chief countries supplying the flour are the United States and Canada.

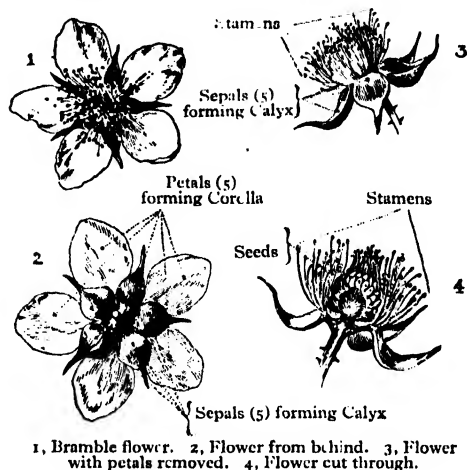
In 1918 the exports of grain and flour from the United Kingdom amounted to the value of £440,419, sent chiefly to Norway, the Canaries, and the Channel Islands.

Flourens (flō-rān), Gustave, French Socialist, born at Paris 1838, died 1871. In 1863 he was deputy professor in the Collège de France, and published his lectures, under the title of *Histoire de l'Homme and Science de l'Homme*. After being engaged in democratic movements in Turkey and Italy, he joined the Paris Commune in 1871, and was killed.

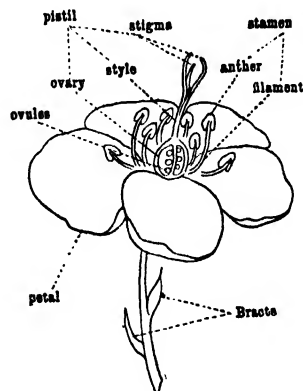
Flourens (flō-rān), Marie Jean Pierre, French physician and physiologist, born 1794, died 1867. In 1828 he was elected a member of the Academy of Sciences, and in 1832 was appointed to the chair of comparative anatomy at the Jardin des Plantes, Paris. In 1833 he became permanent secretary to the Academy of Sciences, in 1840 a member of the French Academy. In 1846 he was created by Louis Philippe a peer of France. His works include: *Expériences sur le système nerveux*, *Développement des os*, *Anatomie de la peau*, *Mémoires d'anatomie et de physiologie comparées*, *De l'Instinct et de l'Intelligence des animaux*.

Flower, in popular language, the blossom of a plant, consisting chiefly of delicate and gaily-

coloured leaves or petals; in botany, the organs of reproduction in a phenogamous plant. A complete flower consists of *stamens* and *pistil* together with two sets of leaves which surround and protect them, the *calyx* and *corolla*. The



stamens and pistils are the essential organs of the flower. They occupy two circles or rows, the one within the other, the stamens being in the outer row. The stamens consist of a



Tea-flower with only a few stamens, ovary cut open (calyx not shown).

stalk or *filament* supporting a roundish body, the *anther*, which is filled with a powdery substance called the *pollen*. The pistil consists of a closed cell or *ovary* at the base, containing *ovules*, and covered by a *style* which terminates in the *stigma*. These organs are surrounded by the corolla and calyx, which together are called the *floral envelope*, or, when they both

display rich colouring, the *perianth*. The leaves of the corolla are called *petals*, and those of the calyx *sepals*. Some flowers want the floral envelope, and are called *achlamydeous*; others have the calyx but are without the corolla, and are called *monochlamydeous*. Flowers are generally *bisexual*, but some plants have *unisexual* flowers; that is, the pistils are in one flower and the stamens in another. See *Botany*.

Flower, Sir William Henry, zoologist and comparative anatomist, was born at Stratford-on-Avon in 1831, died in 1899. He was a student of University College, London, and studied medicine and surgery at Middlesex Hospital. During the Crimean War he acted as an assistant surgeon, and from 1859 to 1861 he held a post in the Middlesex Hospital. In 1861 he was appointed conservator of the museum of the Royal College of Surgeons, and in 1870 Hunterian Professor of Comparative Anatomy and Physiology. These posts he held until his appointment in 1884 as director of the Natural History Museum at South Kensington, which he developed very successfully on both its scientific and popular sides. He resigned his position in 1898, and died the following year. He was for twenty years president of the Zoological Society, a Fellow of the Royal Society from 1864, and in 1880 he was president of the British Association at their Newcastle-on-Tyne meeting. In 1892 he was made K.C.B. The brain was a favourite subject of his investigations. His works include: *Introduction to the Osteology of the Mammalia* (1870), *Fashion in Deformity* (1881), *The Horse* (1892), and *Essays on Museums and other Subjects connected with Natural History* (1898).—Cf. R. Lydekker, *Sir William Flower* (English Men of Science Series).

Flowering-fern, the popular name of *Osmunda regalis*, nat. ord. Osmundaceæ. It is the noblest and most striking of the British ferns, and grows in boggy places and wet margins of woods. It derives its name from the upper pinnae of the fronds being transformed into a handsome panicle covered with sporangia.

Flowering Plants, the most highly organized section of the plant kingdom, distinguished by the possession of flowers and seeds—hence also called seed-plants or Spermatophytes—comprising the two groups Angiosperms and Gymnosperms.

Flowering-rush (*Butōmus umbellatus*), nat. ord. Butomaceæ, a beautiful plant found in pools and wet ditches of England and Ireland, but rare in Scotland. The leaves are 2 to 3 feet long, linear, triangular, their sharp edges sometimes cutting the mouths of cattle, whence their generic name *Butōmus* (ox-cutting). The scape or flowering stem terminates in a large umbel of rose-coloured flowers.

Flowers, formerly a chemical name for fine particles of bodies in the form of a powder or mealy substance, as the *flowers of sulphur*.

Flowers, Artificial, imitations of real flowers, made of various materials. These are not a modern invention. The Romans excelled in the art of imitating flowers in wax, and in this branch of the art attained a high degree of perfection. The Egyptian artificial flowers were made of thin plates of horn stained in different colours, sometimes also of leaves of copper gilt or silvered over. In modern times the Italians were the first to acquire celebrity for the skill and taste they displayed in this manufacture, but they are now far surpassed by English and French manufacturers, but more especially by the latter. Among materials used in this manufacture are cambric, muslin, satin, velvet, and other woven fabrics, feathers, india-rubber, blown glass, mother of pearl, and brass.

Flower Shows, a class of exhibition which has long enjoyed a well-established popularity, as combining the most practical utility with the pleasures of a social gathering. They were the natural result of the foundation of horticultural societies. The first of these, the Royal Horticultural Society of London, was established by Andrew Knight in 1804, and incorporated five years later. The Caledonian Horticultural Society dates from 1809, and the Royal Horticultural Society of Ireland from 1830. The Temple Flower Show, held annually in May by the Royal Horticultural Society of London, offers a magnificent and possibly unique display; while the grounds of Chelsea Hospital, Holland House, and the Crystal Palace are favourite places for such exhibitions. It was at the Crystal Palace that in 1891 was staged what is probably the record number (4191) of exhibits at a flower show, held in connection with the National Co-operative Festival. But, fortunately, flower shows are not confined to such immense displays. Almost every county, many towns—among which Shrewsbury is pre-eminent—and even villages, have their own shows, held under the auspices of local societies. Such exhibitions, which in rural districts frequently offer prizes for the best-kept cottage gardens, excite a healthy spirit of emulation among both professional gardeners and working-class amateurs, of which one consequence is an obvious moral benefit. Many flower shows include fruit and vegetables in their exhibits; others are devoted to roses, sweet-peas, carnations, or to such 'show' plants as the dahlia and pelargonium.

Fluid. Matter is found in three different states or phases—solid, liquid, and gaseous. The name fluid is used as equivalent to non-solid, so that both liquids and gases are fluids.

The distinguishing property of a fluid is its incapability of permanently resisting forces tending to change its shape. Judged by this definition, certain substances, usually considered as solids, must be taken to be fluids, e.g. lead, cobbler's wax, ordinary sealing-wax, and ice. A piece of cobbler's wax laid on a level table will in course of time become flattened out, that is, it flows; and a leaden bullet placed upon the wax, or a piece of cork placed under it, will in time force its way through to the other side. Both a liquid and a gas have, per unit mass, a definite volume at given temperature and pressure. A gas, however, fills the whole volume of any closed vessel which contains it, the pressure adjusting itself to the volume and the temperature. A liquid, on the other hand, if placed in a closed vessel, will in general occupy, as liquid, only a portion of the volume of the vessel, but will give off vapour until a certain definite point of equilibrium is reached, depending on the original mass of liquid, the volume of the vessel, and the temperature. See *Elasticity; Gases, Properties of; Hydrodynamics; Liquid; Viscosity*.

Flukes, or **Fluke-worms**, a name given to certain parasitic animals belonging to the phylum Platyhelminia or Flat-worms, and included in the class Trematoda. They inhabit various situations in different animals—mostly in birds and fishes, and the life-history is complex. The adult *Distoma hepaticum* exists in large numbers in the livers of sheep, and causes the disease known as 'rot'. Part of its life-history is spent in a small water-snail (*Limnaeus truncatulus*), from which it emerges to encyst on grass. Should this be eaten by a sheep, the adult stage may be attained.

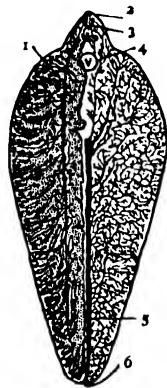


Diagram of Liver Fluke (*Distoma hepaticum*)

1, Chief nerve. 2, Mouth.
3, Nerve ring. 4, Ventral sucker. 5, Main excretory duct. 6, Excretory pore.

Fluohydric Acid. See *Hydrofluoric Acid*.

Fluores'cence, an optical effect in which a body becomes luminous when placed in sunlight or when acted on by certain radiations. Substances such as paraffin oil, uranium or canary glass, and chlorophyll exhibit, in bright sunlight, a surface colour which is different from that of the body of the substance. The effect is brought out in a more striking manner

by placing the substances in a dark room in the path of a beam of invisible ultra-violet rays, when these substances become luminous. They have the property of absorbing the short invisible waves and of emitting, in their place, longer waves capable of affecting the eye. The fluorescent light lasts only so long as the body is receiving the stimulating radiation; in the case of paraffin oil, the light is blue, that from uranium glass is green, whilst a solution of chlorophyll gives a dark-red fluorescence. The term fluorescence was derived from fluor-spar, one of the substances in which the effect was first observed. Some fluorescent solids lose their optical property when in a state of solution; other substances are fluorescent in solution, but not when solid. Fluorescence can be excited by the action of radium and of X-rays. This property is employed in the fluorescent screen, a sheet of stiff paper covered with a thin layer of barium platino-cyanide crystals, used in detecting short-wave radiation. Fluorescence may be classed under the more general term of luminescence, or the emission of light by a body which has not been raised to the high temperature usually associated with the emission of light.—**BIBLIOGRAPHY:** Winkelmann, *Handbuch der Physik*; S. P. Thompson, *Light, Visible and Invisible*.

Fluoride, in chemistry, any salt of hydrofluoric acid (Hf). Calcium fluoride or fluor-spar (CaF_2) and cryolite or sodium aluminium fluoride ($\text{AlF}_3 \cdot 3\text{NaF}$) are two of the best-known naturally occurring fluorides. Others may be obtained by neutralizing the acid with metallic hydroxides or carbonates.

Fluorine (symbol, F; atomic weight, 19), an element which occurs widely distributed in small quantity, always in combination with metals, e.g. fluor-spar (CaF_2), cryolite ($\text{AlF}_3 \cdot 3\text{NaF}$), &c. Owing to the great activity of the element it is extremely difficult to isolate. Moissan in 1886 obtained fluorine by electrolysis of a solution of potassium fluoride in hydrofluoric acid contained in a platinum tube. It is a greenish-yellow gas, and is extremely active, combining readily with most elements with the exception of oxygen. It decomposes water, glass, &c., and explodes on mixing with hydrogen. In the combined state fluorine has been detected in bone, teeth, blood, milk, and urine; in plants and in numerous rocks and minerals. Combined with hydrogen it forms hydrofluoric acid.

Fluor-spar, **Derbyshire Spar**, or **Fluorite** (CaF_2), fluoride of calcium, a common mineral found in great beauty in Derbyshire. It generally occurs massive, but crystallizes in simple forms of the cubic system—commonly the cube, and, more rarely, the octahedron. The cleavage is conspicuous, parallel to the planes of the octa-

hedron. Pure fluor-spar contains 48.7 per cent fluorine, 51.3 calcium. It is of frequent occurrence in limestone and in altered granites, especially in connection with metalliferous ores, as of tin and lead. It is sometimes colourless and transparent, but more frequently it exhibits tints of purple, green, yellow, and red. From the general prevalence of a blue tint in the Derbyshire specimens it is there known as *Blue John*. It is often beautifully banded, especially when in nodules, which are much prized for the manufacture of vases, and it is made into a great variety of articles, chiefly ornamental. It is used as a flux in metallurgy, and is a source of hydrofluoric acid. Its specific gravity is 3.14, but it is of low hardness (4), being scratchable by apatite.

Flushing (Du. *Vlissingen*), a seaport in Holland, province of Zeeland, on the Island of Walcheren, at the mouth of the Hond, or West Schelde, here between 2 and 3 miles broad. It is strongly fortified, and has an extensive trade. There is a regular steamer service between Flushing and Queenborough, in Kent. Pop. 22,431.

Flute, a wind musical instrument, consisting of a straight tube having six holes for the fingers, and from one to fourteen keys which open other holes. The sound, which is soft and clear in quality, is produced by blowing with the mouth across an oval aperture at the side of the upper end of the instrument. Its useful compass is about two and a half octaves, including the chromatic tones. It is usually made in four pieces, and of box or ebony, sometimes, however, of ivory, silver, or even of gold.

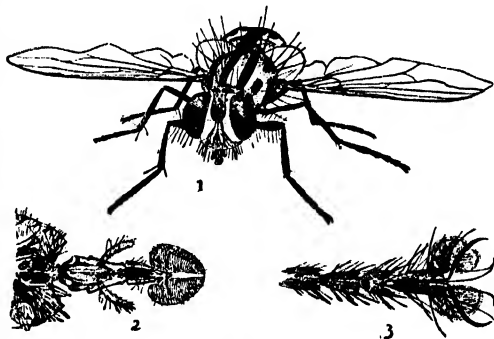
Fluting, in architecture, channels or furrows cut perpendicularly in the shafts of columns. It is used in the Doric, Ionic, Corinthian, and Composite orders, but never in the Tuscan. When the flutes are partially filled up by a smaller round moulding, they are said to be *cabled*.

Flux, a substance or mixture added to a furnace charge, to combine with the gangue minerals and form a fusible slag. (Gangue is the name given to the earthy or mineral extraneous matter usually found associated with the valuable minerals in ore deposits.) The flux required varies with the nature of the gangue; if this is siliceous, limestone or iron ore is used; but if it is basic, a siliceous flux is added. In the smelting of iron ores, limestone is largely used as a flux, the slag formed being mainly a silicate of lime and alumina. The fluxes made use of in assays or chemical experiments consist usually of alkalis and alkaline salts, as borax, cyanide of potassium, carbonate of potassium, carbonate of sodium, common salt, which render the earthy mixtures fusible by converting them into glass.

The fluxes used in pottery are various, but almost all consist of litharge or red-lead, borax, carbonates of potassium and sodium, and sand. In soldering operations fluxes are used to prevent oxidation and to dissolve any oxide which may be formed, the common fluxes being tallow, resin, and zinc chloride.

Fluxions, a term in mathematics. We owe the Doctrine of Fluxions to Newton, who considered variables to be determined by the velocity or rate of flux of their increments. The name fluxion was given to the rate of generation of the variable quantity. This method of analysis is now known as the infinitesimal calculus, but Newton's notation has been replaced by that of Leibnitz, except occasionally in dynamics. The friends of Leibnitz disputed Newton's claim to be the sole discoverer of the calculus, and a long and bitter controversy ensued. There seems no doubt that Leibnitz received his first ideas on the subject from Newton, although he afterwards made valuable advances on his own account. A complete and systematic treatment of fluxions was given by the celebrated Scottish mathematician, Colin Maclaurin. See a valuable paper by G. A. Gibson, *The Analyst Controversy*, in the Proceedings of the Edinburgh Mathematical Society, vol. 17, 1899.

Fly, a winged insect of various genera and species, whose distinguishing characteristics are



House-fly (*Musca domestica*)

1, Enlarged view. 2, Highly magnified view of proboscis.
3, Highly magnified view of foot.

that the wings are transparent and have no cases or covers. By these marks flies are distinguished from beetles, butterflies, and grasshoppers. The true flies or Diptera have only two wings, viz. the anterior pair. In common language, *fly* is the house-fly, of the genus *Musca*. The house-fly is found wherever man is, and in hot weather not only causes a good deal of annoyance, but also distributes the germs of several infectious diseases. It is furnished with

a suctorial proboscis, from which, when feeding on dry substances, it exudes a liquid that dissolves them. From its feet being beset with hairs, each terminating in a disc which is supposed to act as a sucker, it can walk on smooth surfaces, as a ceiling, even with its back down. The female lays her eggs in dung or refuse; the larvæ are small white maggots. They change into pupæ without casting their skins, and in from eight to fourteen days the perfect fly emerges. The very small flies and the very large ones often seen about houses belong to other species. See *Blow-fly*; *Bot-fly*; *Gad-fly*.

Fly-catcher, a name originally given to certain perching birds of the genus *Muscicapa*, with a bill flattened at the base, almost triangular,



Spotted Fly-catcher (*Muscicapa grisola*)

notched at the upper mandible, and beset with bristles. Two species are British—the spotted fly-catcher (*M. grisola*) and the pied fly-catcher (*M. atricapilla*), both about the size of a sparrow. They perch on a branch, where they remain immovable, watching for insects, only leaving to make a sudden dart at a passing fly, which they seize with a snap of the bill, and then return. The white-collared fly-catcher (*M. collaris*) is a native of Southern Europe. Numerous other birds receive the name of fly-catchers, and some, as the paradise fly-catchers (*Terpsiphone*) of the Old World, are brilliantly coloured. In America some of the tyrant birds (*Tyrannidæ*) are named fly-catchers.

Fly-flowers, those which are pollinated by flies, such as the ivy; many are carrion-flowers (q.v.).

Flying-bridge, a bridge constructed very rapidly for some special purpose, usually one of emergency. During the European War the construction of flying-bridges was carried to a high degree of perfection. A standard design of bridge, consisting of two side girders, made of

very light rods, was designed, and the parts were standardized. The parts were few in number and very simple, and the Royal Engineer crews became so proficient that a bridge to carry a load of tanks could be erected over a stream 75 feet wide in 2½ hours by 52 men.

Flying-buttress, in architecture, a form of buttress used in Gothic churches. It is designed to take the thrust of the nave vault, and takes the form of a sloping arch between two vertical buttresses. See *Buttresses*.

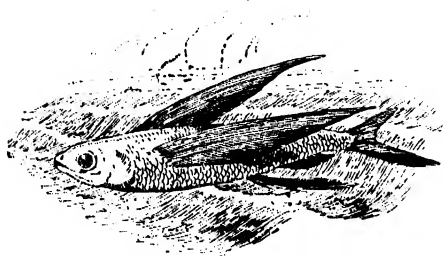
Flying Corps, or, as it is now called, the *Royal Air Force*, is a separate branch of the armed forces of the State under a Secretary of State for Air. In the years immediately preceding the war two more or less experimental forces were in existence, known respectively as the Royal Flying Corps and the Royal Naval Air Service. Of these the R.F.C. formed a branch of the army, and the R.N.A.S. of the navy, and the personnel was drawn from those services, i.e. officers were seconded from the army or navy for service in one or the other. In Aug., 1914, the total strength of the two flying services was 285 officers and 1835 other ranks. During the next three years the two services, still working separately, increased to such an extent that by Dec., 1917, their total combined strength had reached 20,287 officers and 147,289 other ranks. Experiments had also been made with a view to co-ordinate the activities of the two services by the formation of an Air Board (May, 1916), and the appointment of a Director-General of Air Services.

On 2nd Jan., 1918, the status of the Air Board was changed to that of an Air Council under a Secretary of State (Lord Rothermere), and a Chief of the Air Staff (Major-General Trenchard). This was followed three months later by the final amalgamation of the two services under the title of the Royal Air Force (1st April, 1918). By October of that year the strength of the reorganized service had reached 27,906 officers and 263,842 other ranks. The full-dress uniform of the R.A.F. is light blue, and general officers are known as air-marshals and air-commanders. Pilot officers are called wing-commanders, squadron leaders, and flight-lieutenants. A Cadet College for the training of applicants for commissions as pilot officers was opened at Cranwell in Feb., 1920.

Flying Dutchman, a phantom ship said to be seen in stormy weather off the Cape of Good Hope, and thought to forebode ill-luck. One form of the legend has it that the ship is doomed never to enter a port on account of a horrible murder committed on board; another, that the captain, a Dutchman named Vanderdecken, swore a profane oath that he would weather the Cape though he should beat there till the last

day. He was taken at his word, and there he still beats, but never succeeds in rounding the point. He sometimes hails vessels and requests them to take letters home from him. The legend is supposed to have originated in the sight of some ship reflected from the clouds. It has been made the groundwork of a novel by Marryat (*The Phantom Ship*), and an opera by Wagner (*Der Fliegende Holländer*).

Flying-fish, a name common to various fishes which have the power of sustaining themselves



Flying-fish (*Exocetus evolvans*)

for a time in the air by means of their large pectoral fins. Generally, however, the name is limited to the species of the genus *Exocetus*, which belongs to the family Scomberesocidae (mackerel-pikes). The pectoral fins, which are very large, are the principal instruments in their flight, serving to sustain the fish temporarily in the air after it has acquired an initial velocity in its rush through the water. It can pass through the air to a considerable distance, sometimes as much as 200 yards, which it does to escape from the attacks of other fishes, especially the dolphin (*Coryphæna*). It is most common between the tropics. The best-known species are *E. volitans*, abundant in the warmer parts of the Atlantic, and *E. exilis* of the Mediterranean. The name is also applied to the flying gurnards (*Dactylopterus*), native to the hotter regions of the Atlantic and Indian Oceans. These fishes move their large pectoral fins rapidly, but their 'flights' are less extended than those of *Exocetus*.

Flying-fox. See *Fox-bat*.

Flying-lemur, a name given to insectivorous mammals, natives of the Indian Archipelago and belonging to the genus *Galcopithécus*, which constitutes a sub-order (Dermoptera) of the Insectivora. They possess a flying-membrane, which extends as a broad expansion from the nape of the neck to the tail. By means of this membrane they can parachute from branch to branch.

Flying-phalanger, a popular name of the members of a genus of nocturnal marsupials (*Petaurus*) nearly allied to the true phalangers.

A fold of the skin extends along the flanks, and this, acting as a parachute, enables the animal to glide for great distances, its heavy tail serving as a rudder to guide its course in the air. These animals inhabit New Guinea and Australia, where they are known as 'flying-squirrels'. The species vary in size, the smallest being no bigger than a mouse. They feed on fruit, leaves, and insects.

Flying-squid, the popular name of a genus of cephalopodous molluscs (*Ommastræphes*), allied to the calamaries or squids, having two large lateral fins, which enable them to leap so high out of the water that they sometimes fall on ships' decks.

Flying-squirrel (*Sciuropterus*, *Pteromys*, and *Eupetaurus*), three genera of rodent animals, family Sciuridae (squirrels), to which the skin of the flank, extending between the fore and hind legs, imparts the faculty of supporting themselves in the air, as by a parachute, and gliding for considerable distances. The European flying-squirrel (*Sciuropterus sibiricus*) is a native of the forests in the colder parts of Europe and Asia; the American flying-squirrel (*P. volucella*) lives in troops in the western parts of North



Flying-squirrel (*Pteromys petaurista*)

America. *Pteromys* includes larger forms native to the Oriental region, and *Eupetaurus* includes a single species from North India and Tibet.

Fly-trap, the only species known of a genus of plants (*Dionæa*, nat. ord. Droseraceæ, also called Venus's fly-trap.

Fly-wheel, a cast-iron wheel designed to provide an engine or appliance with rotational inertia. The bulk of the weight of the wheel is in the rim at the maximum distance from the axis of rotation. In this way the maximum rotational inertia is obtained with the minimum amount of material. In designing the wheel

the governing principle is to make it massive enough to give the necessary rotational inertia, and strong enough to resist the centrifugal force to which it will be subjected when in rotation.

—BIBLIOGRAPHY: D. A. Low, *Applied Mechanics; Modern Mechanical Engineering* (Gresham Publishing Company).

Foch, Ferdinand, French soldier, was born in Tarbes, in the department of Hautes-Pyrénées, on 2nd Oct., 1851. Tarbes is a city of some 20,000 inhabitants, and at the time of Ferdinand's birth his father held the position of Secretary-General of the Prefecture. Through his mother, Foch is descended from an officer who attained a considerable eminence under Napoleon. M. Foch's position as a civil servant making periodical changes of residence a matter of course, Ferdinand was, in his earlier life, sent to different local schools; and it was not till his eighteenth year that he was entered as a pupil in the College of St. Clement at Metz, with a view to preparing himself for the École Polytechnique. The outbreak of the Franco-German War caused an interlude in his studies, and the young Foch joined the army and was posted to an infantry depot. On the conclusion of peace in 1871 he returned to Metz to complete his studies, and, in November of the same year, entered the École Polytechnique. Here he remained till early in 1873, when he was transferred to the École d'Application at Fontainebleau, a school for artillery and engineers. In Oct., 1874, he was gazetted lieutenant in the artillery and posted to the 24th Regiment of Artillery at Tarbes, his birth-place. Three years later he went through the cavalry school at Saumur, and on leaving it was promoted captain. During his period at Saumur he married Mlle Julie Bienvenue. In 1885 Captain Foch was sent to the École Supérieure de Guerre in Paris. After two years at the war school or staff college, he was appointed to the staff of a division, till in 1891 he was recalled to Paris as a major on the General Staff. After this he had an interval of regimental duty in command of a horse-artillery battery, and in 1895 he was appointed professor of military history, strategy, and applied tactics at the École Supérieure de Guerre. Here he made his mark, as is evident from a contemporary appreciation of him in the *Correspondant*. In 1900 Lieutenant-Colonel Foch left the École de Guerre, and, after a period of regimental and staff service, was promoted brigadier-general on the General Staff, and was offered and accepted the post of Director-in-Chief of the École de Guerre. In 1911 Foch was promoted to the rank of general of division, and took over command of the 13th Division at Chaumont. The following year saw him transferred to the command of the 8th Army

Corps at Bourges, and in 1913 to that of the 20th Corps at Nancy, forming part of General de Castelnau's Second Army. This was his command when the European War broke out.

At the head of his corps Foch took a prominent part in the operations in Lorraine in the month of Aug., 1914, though towards the end of that month he was ordered by General Joffre to report himself for duty at General Headquarters. Here he found that he had been selected to take command of the Ninth Army, then in process of formation out of corps and divisions taken from other armies. The retreat to the Marne was in progress, and it was in view of an eventual counter-stroke that reorganizations were being carried out. Foch established his headquarters temporarily at Châlons, and proceeded to form and know his new command. When the great retreat at last came to an end on 5th Sept., 1914, Joffre issued his orders for the counter-attack which will be known to all time as the first battle of the Marne. In this series of operations the duties assigned to the Ninth Army were as follows: "The Ninth Army will cover the right of the Fifth Army, and hold the southern approaches to the marshes of Saint Gond. A portion of its forces will occupy the plateau north of Sézanne." The distribution of the various armies was such that, according to this arrangement, Foch's command was in the centre, and was opposed to the Second and part of the Third German Armies under von Bülow and von Hausen. The offensive started on 6th Sept., and by the 8th Foch's command had been severely handled. It was in accordance with his invariable teaching, that the best defence is offence, that he is said to have sent the following laconic message to General Headquarters: "My centre is giving way, my right is falling back; the situation is excellent. I shall attack." And he attacked with such success that on the 10th the Germans retreated. For his services on this occasion General Foch was awarded the Grand Croix of the Legion of Honour. Early in October, Foch was appointed associate to the Commander-in-Chief, to co-ordinate movements of all Allied troops defending the coast, i.e. from the Oise to the sea, unity of command being thus established in some small measure and being made possible by his personality. During 1916 Foch had much to do with the preliminary arrangements for the battle of the Somme, and, when in September of this year he reached the age limit, he was specially retained on the active list and given the Médaille Militaire, which, given to a general officer, is the highest honour which the French Government can award. He also became head of the Board for the Investigation of Inter-Allied Military Questions. In May, 1917, he became Chief of

the Staff vice General Pétain, appointed Commander-in-Chief; in October he visited Italy to discuss with the Italian General Staff the measures necessary to stabilize matters there. At the same time he was President of the Inter-Allied War Council which had been constituted at Versailles, and which was faced with the problem of deciding on the measures necessary to meet the expected German attack on the Western Front. Not until this great attack had taken place, and all but succeeded, was the principle of the single command finally recognized and agreed to, Foch becoming Generalissimo of the French, British, Belgian, and American armies on 26th March, 1918; and to Foch in his new position is due the credit of the great counter-stroke which saved the situation at the second battle of the Marne, and which was the beginning of the end. The French Government marked their thankful appreciation of his great services by bestowing upon him the dignity and rank of a Marshal of France, and on 23rd Aug., 1918, the *bâton* was presented to him by the President of the Republic at General Headquarters. As an author Marshal Foch's fame rests principally on two books, both of which grew out of lectures at the École de Guerre. These are *The Principles of War* and *The Conduct of War*. It is interesting to compare an extract from the first, published in 1900, with the opening section of the British *Field Service Regulations*, part i, of 1909.

"A battlefield does not give any opportunity for study; one does what one can to apply what one already knows, therefore it is necessary that one should know thoroughly and be able to use one's knowledge quickly." (*Principles of War*.)

"The principles . . . should be so thoroughly impressed on the mind of every commander that, whenever he has to come to a decision in the field, he instinctively gives them their full weight." (*Field Service Regulations*, part i, section 1, paragraph 1.)—BIBLIOGRAPHY: Raymond Recouly, *Foch*; R. Puaux, *Marshal Foch*; A. H. Atteridge, *Marshal Ferdinand Foch*; E. G. Marks, *How Foch makes War*.

Fochabers (foh'a-berz), a village in Scotland, Morayshire, 8 miles E.S.E. of Elgin, with an important endowed school and a library and reading-room. In the vicinity is Gordon Castle, the magnificent seat of the Duke of Richmond and Magnificence. Pop. 1749.

Focus, (1) in optics, a point through which all the rays of a beam of light pass, after their directions have been changed either by reflection at a mirror, or refraction by a lens. A focus may be *real*, or *virtual*. It is real if the light actually goes through it, virtual if the rays have to be produced backwards in order to come to

a point. In practically all cases, the rays do not pass exactly through a focus, but only near it. (2) In geometry, a point having properties of a special kind in relation to a curve. A conic section, e.g., may be defined as the locus of a point whose distance from a fixed point, called the focus, bears a constant ratio to its distance from a fixed line, called the directrix. The ellipse and the hyperbola have two foci. In the ellipse the sum, in the hyperbola the difference, of the distances of any point on the curve from the foci is constant. In modern geometry, a focus of any curve is defined as a point of intersection of tangents to the curve from the circular points at infinity.

Fog, a cloud at or near the surface of the earth, produced by the condensation of the invisible vapour of the atmosphere into minute watery particles, this condensation being caused by a cold current of air, or the contiguity of a cold surface. Fogs are more frequent in those seasons of the year when there is a considerable difference of temperature in the different parts of the day. In low, moist places, and in confined places, as valleys, bays, or lakes, surrounded by high lands, they are much more prevalent than in open countries or elevated spots, where they are quickly dispersed by the winds. The disagreeable pungency of fogs in large towns is due to the presence of smoke and other impurities. In fact, fogs may be produced by accumulation of smoke. This happens particularly when there is what is called an inversion of temperature, that is, when the air near the earth is colder than that above. This condition prevents the rising of the surface air and its warming by mixing with the higher air. The fog also hinders the sun's rays warming the earth, and thus in a calm type of weather such fog may be very persistent. Various experiments have been made with a view to finding a means of dispersing fogs, but none have as yet been successful.

Fogazzaro, Antonio, Italian novelist and poet, born at Vicenza in 1842, died in 1911. He studied divinity and literature, law and music at Padua and Turin, and published his first poetic romance, *Miranda*, in 1874. This was followed in 1876 by *Valsolda*, a volume of lyrics, which brought him only little recognition. Fogazzaro then turned to fiction, published *Malombra* (1881) and *Daniele Cortis* (1887), and obtained a considerable success with his idyll *Il Misterio del Poeta* (1888). His greatest work, however, upon which his fame chiefly rests, is his *Il Santo* (The Saint, 1905), which has been translated into several European languages. It is the last of his famous trilogy, the first two being *Piccolo Mondo Antico* (1895) and *Piccolo Mondo Moderno* (1901). In this work, which caused a great stir, the author expressed his sympathy with

the principles of Modernism, and endeavoured to reconcile the teaching of the Catholic Church with the theories of evolution.

Foggia (foj'á), a town of S. Italy, province of Foggia, 79 miles N.E. of Naples, with regular and spacious streets. Its principal edifice is a Gothic cathedral erected in 1179, destroyed in 1731, and afterwards rebuilt. The trade is chiefly in corn, for which immense granaries have been formed under the streets. Pop. 79,213.—The province, which is partly bounded by the Adriatic, has an area of 2683 sq. miles. It possesses rich pastures, and produces saffron and wine. Pop. 484,557.

Fog-signals, signals given by means of sound to warn vessels during fogs, when lights or other

laid on the rails and exploded by the engine when it comes up to them. In recent times radio-signals have been used for the purpose of determining positions in fogs.

Föhr (feur), one of the North Frisian Islands in the North Sea, off the west coast of Schleswig; area, 28 sq. miles; pop. about 4000, mostly Frisians engaged in fishing, the capture of wild fowl, and agriculture.

Foils, the exercise associated with the use of the fencing-foil, a small sword 33 inches in length, tapering gradually from hilt to point, manufactured as light as possible, and tipped with a leather button to prevent injury. It is essentially a weapon to thrust with and not to cut. It was used in this country for the first time in Elizabeth's reign, and since then it has been regarded as a particularly suitable weapon for duelling. Whilst originally the education of every man of quality and fashion was regarded as incomplete without considerable practice in the use of the foil, the exercise of fencing has fallen into disuse, more so in this country than on the Continent. The Continental nations display very marked superiority in international contests such as the Olympic Games. In Great Britain prominent contests are exceedingly few and restricted to very few competitors, as in the Public Schools Championships, which are conjoined with boxing and gymnastics, the Inter-'Varsity meeting (Oxford and Cambridge), and the Amateur Championships. A few fencing-clubs are also in existence, often associated with well-known schools and teachers of the art, and the gymnasium of every public school possesses in its sergeant, usually a retired non-commissioned officer, a competent instructor. Nevertheless, considering the excellence of the exercise, its comparative neglect is to be deplored.

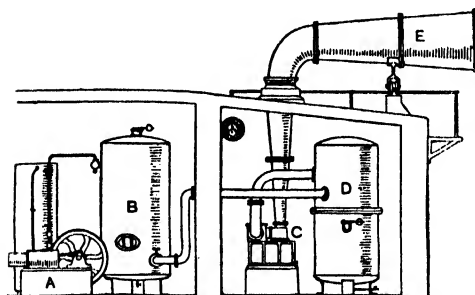
Foix, Gaston de. See *Gaston*.

Foix (fwá; Lat. *Furum*), a town of France, capital of department of Ariège, in a valley at the foot of the Pyrenees, with remains of the old castle of the Counts of Foix, and an old church and abbey. Pop. 6080.

Fokien, a maritime province of South-Eastern China; area, 46,320 sq. miles. The Strait of Formosa separates it from the island so named. The coast is deeply indented by bays and studded with islands. The interior is generally mountainous, but is highly cultivated and generally fertile. The principal products are rice, wheat, barley, tea, silk, sugar, indigo, camphor, and tobacco. The capital is Foo-chow. Pop. 25,790,556.

Fokker, a German type of aeroplane, built by a Dutch aviator, A. H. S. Fokker, and employed during the European War.

Fokshani (-shā'nē), or **Focsani**, a town of Roumania, in Moldavia, on the Miklov, 104



Fog-horn and Apparatus

A, Oil engine. B, Compressed air receiver. C, Siren.
D, Air container. E, Horn.

visible signals cannot be perceived. Various kinds of fog-signals are used, among which may be mentioned bells, drums, gongs, guns, compressed-air whistles, steam-whistles, and fog trumpets or horns. One of the most powerful signals is the siren fog-horn, the sound of which is produced by means of a disc perforated by radial slits made to rotate in front of a fixed disc exactly similar, a long iron trumpet forming part of the apparatus. The discs may each contain, say, twelve slits, and the moving disc may revolve 2800 times a minute; in each revolution there are, of course, twelve coincidences between the slits in the two discs; through the openings thus made steam or air at a high pressure is caused to pass, so that there are actually 33,600 puffs of steam or compressed air every minute. This causes a sound of very great power, which the trumpet collects and compresses, and the blast goes out as a sort of sound beam in the direction required. Under favourable circumstances this instrument can be heard from 20 to 30 miles out at sea. Fog-signals are also used on railways during foggy weather; they consist of cases filled with detonating powder, which are

miles N.E. of Bucharest, with an important trade. Pop. 25,287.

Folc-land, that is Folkland, the land of the people, that portion of Anglo-Saxon England which was retained on behalf of the community. It might be occupied in common or possessed in severalty, but could not become allodial estate or absolute private property except with the consent of the Witan or highest council in the land. From time to time large grants were made both to individuals and to communities; and land thus cut off from folc-land was called *hoc-land* or 'book-land'. Ultimately the king practically acquired the disposal of it, and the remnant of folc-land became Crown lands. See *Feudal System*.

Foleshill, a town of England, in Warwickshire, 2 miles north-east by north of Coventry. The principal trade is in ribbons, fringes, and elastic for boots. There are coal- and ironstone-mines in the neighbourhood. Pop. 33,195.

Foley, John Henry, sculptor, born in Dublin 1818, died at Hampstead 1874, and is buried in St. Paul's Cathedral. He was admitted a student of the Royal Academy in 1835. In 1848 he was elected an associate, and in 1858 an academician. His works are numerous, and include statues of Selden and Hampden at Westminster; Goldsmith, Burke, and O'Connell in Dublin; Lord Hardinge and Outram in Calcutta; Lord Clyde in Glasgow; the group *Asia* and the colossal statue of Prince Albert for the Albert Memorial, Hyde Park; Stonewall Jackson in Richmond, U.S.A. Without showing much imagination, his work is competent and dignified.

Foligno (fo-lén'yo), a town of Central Italy, province of Perugia, in a beautiful vale of the Apennines, watered by the Clitumnus. Public buildings worthy of notice are the cathedral and the Palazzo Communale. Pop. (commune), 28,373.

Folkestone (fōk'ston), a seaport, England, county Kent, 6 miles w. by s. of Dover, terminus of the South-Eastern Railway, and a chief station for steamers to and from Boulogne. It is a favourite watering-place, and has fisheries, besides a shipping trade. Folkestone is included in the parliamentary borough of Hythe. Pop. 37,571.

Folk-lore. This term refers to the lore (knowledge) of the folk (people) surviving in living tradition, and not acquired from books. It was first used by William J. Thoms ('Ambrose Merton') F.S.A., the founder of *Notes and Queries* (1849), which he edited till 1872, and the author of books on early romances, lays, and legends. Folk-lore has been a subject of serious study since the brothers J. L. K. and W. K. Grimm made collections of *Märchen* (published 1812-5), and showed that these had not only a psycho-

logical but historical value. They adopted the view that Teutonic, Greek, and Indian myths were of Indo-European origin. Mannhardt (1865) paid special attention to the lore associated with the agricultural mode of life surviving among peasants, and found traces of an ancient pagan religious system that had been supplanted by Christianity. His views, especially in connection with vegetation deities, strongly influenced later writers. Hugh Miller, in his *Scenes and Legends* (1835), adopted Dr. W. Robertson's stratification theory. "Man in a savage state", he wrote, "is the same animal everywhere, and his constructive powers, whether employed in the formation of a legendary story or of a battle-axe, seem to expatiate almost everywhere in the same rugged track of invention. For even the traditions of this first stage may be identified, like its weapons of war, all the world over." Tylor, Lang, and Frazer, strongly influenced by Mannhardt and Miller, have emphasized, in their studies of comparative religion, the importance of the 'lower mythology' of folk-lore. W. H. R. Rivers and Elliot Smith have, however, subjected their evolution theory to severe criticism, contending that the resemblances in the beliefs and customs of far-separated peoples are due to direct and indirect cultural contact which took place in ancient times. Differences as well as resemblances must, the anti-evolutionists contend, be accounted for; these, they consider, are due to the mixing of local and imported cultures at various periods and in different districts. They hold it to be hazardous to draw analogies from biological evolution, and adopt instead the historical method. In the folk-lore of agriculture they find the elements of religious beliefs that were distributed from centres of ancient culture with seeds and implements; in the folk-lore of seafarers they detect beliefs that were disseminated by the ancient searchers for pearls, precious stones, and precious metals which had originally a religious value. Laufer, the American Orientalist, has shown that the potter's wheel, which was invented in ancient Egypt, was associated with a complex culture that can be traced in centres of culture in Asia and Europe into which the wheel was introduced. The study of folk-lore, which has become a science, is of great importance in dealing with the development of religious beliefs and symbolism, political institutions, the sciences of medicine, astronomy, and chemistry, the art of story-telling, architecture, painting, sculpture, music, various crafts, &c. Although some of the hypotheses popularized by folk-lorists during the latter half of the nineteenth century have been found to be based on hazardous assumptions, the cumulative influence of these undoubtedly stimulated research, and

every country in the world has been gleaned for collections of folk-lore. A great deal of excellent work has been accomplished in this connection by Christian missionaries. The more intensive study of local folk-lores is nowadays strongly advocated. It has been found, for instance, that even in one small country there are communities that have perpetuated distinctive customs and beliefs, and especially those associated with definite modes of life. As a particular language is not necessarily a certain indication of racial affinities, it is likewise not necessarily associated with identical beliefs in adjoining areas. The folk-lores of Gaelic Ireland and Gaelic Scotland, for instance, are not identical. A pork taboo existed in ancient Scotland and is not yet entirely extinct, while in Ireland pork was eaten as far back as the early years of the present era. The Celts on the Continent kept pigs and cured and ate pork. Although the Celts reached Scotland, and Celtic languages were spoken in that country from an early period, the folk-lore of Scotland reveals in this connection and in other connections traces of the intellectual life of a non-Celtic people or peoples. At the same time certain beliefs and traditions are common to Ireland and Scotland. The folk-lore of England similarly reveals the persisting influences of more than one ancient religious cult, while there are elements in Welsh folk-lore that impart to it a local colouring, the culture-mixing in Wales, despite the existence there of a Celtic language, having apparently been not quite the same as that of Ireland or of Scotland. Folk-lore may be found, when studied in association with archaeology, language, race-types, and artifacts (objects made by man), to throw light on the early history of a country. Some writers regard folk-lore as the floating material from which early mythological systems were framed, and others as the scattered fragments of half-forgotten mythologies. It is possible that both views have in them the elements of truth. In ancient times mythologies were often reflections of local politics, and did not supplant older systems and the stories, beliefs, and customs associated with them. Imported complex beliefs and beliefs of local origin may be found persisting in the living tradition of a single area. Although stories containing mythological elements are rapidly dying out in folk-memory, many ancient superstitions and ceremonies still linger. In the customs associated with Christmas, New Year's Day, Easter, May Day, Hallowe'en, &c., are some of great antiquity. Charms, mascots, &c., are still worn for 'luck', which in ancient times meant everything desired by man, including good health, longevity, good fortune, offspring, and happiness.—BIBLIOGRAPHY: Sir J. G. Frazer, *The*

Golden Bough; W. H. R. Rivers, *Presidential Address, British Association Section H, 1911*; Elliot Smith, *The Migrations of Early Culture*; W. J. Perry, *The Megalithic Culture of Indonesia*; Laufer and Nichols, *The Beginnings of Porcelain in China*; A. Lang, *Custom and Myth*; Sir G. L. Gomme, *Folk-lore as an Historical Science*; J. Rhys, *Celtic Folk-lore*; W. R. S. Ralston, *Songs of the Russian People*; *Transactions of the London Folk-lore Society*.

Folk-music. An art which fails to give expression to those feelings which are inborn in human nature is thereby declared a failure. To this rule music is no exception. The elaborate art of Bach, Beethoven, and Wagner may be compared to a gorgeous flower-garden on which all that culture and knowledge can devise has been expended; but the most highly cultured rose derives ultimately from the flower in the hedge, and without the hedge-flower as a prototype the flower in the garden would be an impossibility. So it is with music; if we are to believe in it as an art and not as a series of tricks without spiritual significance, we must be able to prove that it has its initial impulse in that which is spontaneous to man.

How are we to prove this? How are we to find out whether musical expression can ever be spontaneous, and whether this spontaneous expression, if it exists, has any relation to beautiful music as the great composers have taught us to regard it? To do so we must imagine a man whose musical expression must of necessity be spontaneous and unpremeditated. Such a man must be unlettered, otherwise he could by reading obtain a superimposed musical culture; untravelled, otherwise his music might be imported from outside; unsophisticated, otherwise his music might not be genuinely self-expressive. Unless such a man were given to inventing music, unless his music contained in it the seed of those principles of design and expression which we recognize as beautiful, then, indeed, the whole structure of the art is without foundation.

Now this unsophisticated man is no mere abstraction—even to this day we can find such people, and have proved that they, or their forefathers, have, from time immemorial, invented music; music which is not only often beautiful in itself, but obeys or rather illustrates those principles of artistic beauty which we find in the music of great composers. This is what is known as folk-music.

Some musicians profess surprise that an uneducated countryman should be capable of making beautiful music; but in reality it is the opposite which would be surprising. If we had not actual evidence of the existence of folk-music, we should have to pre-suppose it as an

essential condition of the existence of music as a true art; and, having pre-supposed it, we should have to argue further that the later developments of music must be true to type (as indeed they are), being nothing else than further stages along the road of evolution of which these primitive utterances were the starting-point.

Folk-music is, of course, bounded in its scope; the very conditions of its origin necessitate certain limitations. (1) It is spontaneous and, therefore, unselfconscious. Music-making for its own sake does not occur to the primitive man; it is the occasion, not the resultant expression, which is important to him. Primitive music is an applied art, a vehicle for the declamation of a story or the accompaniment to dancing; it is, therefore, limited in length by the stanza of a ballad or the figure of a dance. (2) The means of performance are limited to the human voice or some primitive instrument, therefore it is almost always purely melodic in its character. (3) It is never written down, since one of the conditions of its existence is that its inventor is unlettered; therefore it exists only in the minds and memories of those who perform it, and must be short enough and simple enough to be learnt by heart.

Now these limitations are not entirely to the disadvantage of folk-music, for they carry with them certain characteristics and qualities which sophisticated music has, to a large extent, lost. (1) The actual shortness of a folk-tune, the fact that it has to be repeated many times in a long ballad or dance, gives a peculiar concentration to the finest examples. The effect of a fine folk-tune is cumulative; it is often not till after several repetitions that its full beauty is realized. (2) Its purely melodic nature gives to folk-music a wide range of melodic character which harmonic music for a long time lost, and which it has only comparatively recently regained. (3) The fact that folk-music exists only by oral tradition has far-reaching effects. Grimm says, "A folk-song composes itself". This is often held to be a mere rhetorical exaggeration. It is argued that if we go back far enough we must eventually come to a moment when any particular melody was invented by some individual man, and that therefore there is no essential difference between a folk-tune and any simple melody which has been composed and written down in the ordinary way. Without discussing whether primitive music was not actually often communally conceived at festivals or religious ceremonies, we will take it for granted, for the sake of argument, that folk-music had its origin in individual invention. Let us grant that the primitive man invented his tune exactly as Beethoven invented a sonata, with this important difference that he cannot write down

what he intends. What happens next? He sings his composition to his friends and neighbours, he teaches it to his children and grandchildren, and after he is dead they continue to sing their versions of it and to pass it on in turn to others. Now it is a well-known fact that each individual performer of a piece of music puts a little of himself into his performance which makes it slightly different from that of anyone else. Where music is stereotyped by print these differences never get very far, since each performer starts with the original printed copy. But we must remember that if the supposed inventor of a folk-song could not write down his invention, neither could his hearers, with the result that in a very short space of time widely varying versions of the same tune will be current; if we add to this the undoubted fact that tunes were often adapted to new words with different metres, or changed from song-tunes into dance-tunes, the possibilities of variation become wider still. It is a common experience among collectors of traditional music to find widely divergent versions of the same tune, and, conversely to find in different tunes certain characteristics which point to a common origin. Nor does this chain of variations point to a process of corruption and disintegration, but of gradual development to meet varied needs and different times; for any tune which does not please its hearers will not be preserved by them, and as there is no written document to keep it alive it will die with its inventor. So that folk-music may be said to be the combined invention, and to represent the combined musical taste, of all its singers and hearers. In one sense it is as old as time itself, in another it lives afresh as something new at the hands of each individual singer.

Folk-psychology, an anthropological study of the psychology of races, nations, and social groups. Whilst folk-lore deals with the study of survivals, folk-psychology is concerned with the mental products in primitive peoples. It studies the effect of climate on mental endowments, and the evolution of national characteristics, and thus deals not only with the food conditions of a people and its habitat, but also with its somatology, æsthetics, jurisprudence, and pathology. Folk-psychology is to be distinguished both from social-psychology, and from race-psychology. In the study of mental development social-psychology is concerned only with the part played by the social factor, whilst the term race-psychology has been applied by Spencer to the science of the evolution of mind in men and animals. Among students of folk-psychology are Felix Adler, Baldwin, Lombroso, Wundt, and Lévy-Bruhl.—Cf. G. le Bon, *Psychology of Peoples*.

Fomentation, in medicine, the application of warmth and moisture to a part of the body, by means of flannels or other cloths dipped in hot water or medicated decoctions, for the purpose of easing pain or increasing the blood-supply by dilating the vessels and so hastening the natural curative processes.

Fomes, a genus of Basidiomycetous Fungi, family Polyporineæ. Some, such as *F. annosus*, are dangerous tree-killing parasites.

Fomorian, the monstrous deities of Irish mythology who are overcome in battle with the beneficent Danann deities. According to De Jubainville, the French Celtic authority, the Irish mythological system resembled that of ancient Greece. He regards the Dananns as Gaelic Olympians, and the Fomorians as Titans. Balor, the leader of the Fomorians, is slain with a stone (the sun) flung by Lugh (pronounced *Loo*), the Danann god, as Argos is slain with a stone by Hermes. De Jubainville's view is that Argos and Balor personified night, while Hermes and Lugh personified the dawn. The derivation of 'Fomorian' or 'Fomore' is uncertain. Rhys suggested *fo-murib*, 'under-seas', but afterwards abandoned this view. In Scottish Gaelic *Fomhair* (pronounced *fou'ar*) signifies 'giant', and the Scottish Fomorians have no particular association with the sea or with darkness. They occupy headlands, and fling boulders at one another across valleys and arms of the sea. Others occupy caves or islands. There are no Dananns in Scotland. According to ancient Irish references, the Fomorians were the gods of the pre-Celtic peoples, the Fir-bolgs (men with the sacks), the Fir-Domnann, the Dumnonii, or Damnonians who occupied Devon and Cornwall, the Strathclyde area of Scotland, and part of Central and South-Western Ireland. Apparently the gods of the earlier people became the demons of the later, or were identified with the demons in their mythological system. Originally 'Fir-bolg' had a definite racial significance, but it was in time applied to subject peoples. 'Fomorian' was likewise loosely applied to seafarers from the Hebrides, &c., who invaded Ireland. It was probably a pre-Celtic term.—BIBLIOGRAPHY: H. D'Arboise De Jubainville, *Le Cycle Mythologique Irlandais et la Mythologie Celtique*; C. Squire, *Celtic Myth and Legend*; D. A. Mackenzie, *Wonder Tales from Scottish Myth and Legend*.

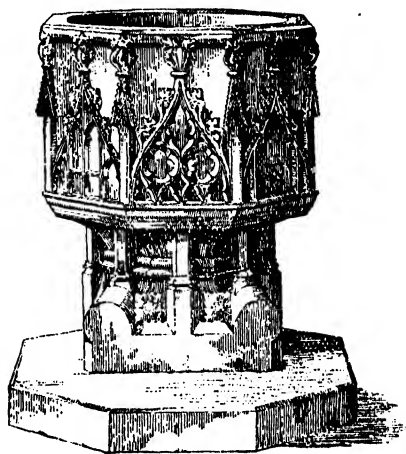
Fonblanque (fon'blangk), Albany William, English journalist, born in 1793, died 1872. He was educated for the Bar, but, devoting himself to journalism, he gained a position on *The Times*, *The Morning Chronicle*, and succeeded Leigh Hunt as editor of *The Examiner*. A reprint of many of his articles, under the title *England under Seven Administrations*, appeared

in 1837. In 1852 he was appointed chief of the Statistical Department of the Board of Trade.

Fond du Lac, a city of the United States, Wisconsin, at the mouth of Fond du Lac River, which opens on Lake Winnebago, 148 miles N.N.W. of Chicago. It is the centre of several railways, and has a large trade. The manufactures include ironfounding, carriage and wagon making, tanning, and saw-milling. Pop. 18,797.

Fondi, a town of South Italy, near a coast lagoon to which it gives name, province of Caserta. It is a bishop's see, and contains a cathedral. Fondi stands in a plain, the ancient *Cæcubus Ager*, which produced the famous Cæcuban wine. Pop. 11,378.

Font. In the early days of the Christian Church the vessel needed for the rite of baptism



Font, Giffey, Hertfordshire. Decorated Gothic Style

took the form of a tank, admitting the complete immersion of adults. It was usually placed in a special building called a baptistery, though bathrooms in large private houses were occasionally used. By the eighth century the baptism of infants was general, and, the rite having been administered in churches as early as 578, the need for economy of space reduced the size of the vessel and produced the font. The earlier form was that of an unmounted and undecorated tub, such as occurs at Tangmere, Sussex, and in still ruder shape at Old Radnor, Radnorshire. For greater convenience the font was presently mounted on legs, at first often five in number, but soon generally combined into a central shaft or pillar. The height was gradually increased, partly by elongation of the shaft, and partly by the whole being mounted on a dais or platform, an elevation which gave the vessel

a more imposing and ceremonial appearance. The basin, though sometimes of local stone, was occasionally of marble or alabaster, polished. Its shape was round, square, or octagonal, the last-named form becoming very general in the fifteenth century; a beautiful specimen is seen at Snape, Suffolk. Decoration, in the form of carving, had become usual in Norman times, resulting in such fine examples as those at Castle Frome and Eardisley, both in Herefordshire, and both apparently by the same designer. Such decoration, when including figures, was usually sacred in character, but the font at Lostwithiel, one of many interesting Cornish specimens, exhibits the Cross, the Virgin, and a mitred abbot in proximity to a huntsman and hound. The use of fonts was forbidden under the Commonwealth, and many were certainly destroyed at this period, but vandalism of a later date is responsible for the loss of others. Among exceptional fonts must be mentioned the twenty-nine English examples in lead, of which no fewer than eight occur in Gloucestershire. Pewter and bronze were also used, while fonts of brick and wood are not unknown, and Guernsey possesses a small silver font. Font-covers, often large and highly decorative, originated in the custom of leaving consecrated water in the font, and in the fear of this being taken for employment in unhallowed magic rites.

Fontaine, Jean de la. See *La Fontaine*.

Fontainebleau (fon-tân-blô), a town of France, department of Seine-et-Marne, in the midst of the forest of same name, about 2 miles from the Seine and 37 miles S.E. of Paris. It owes its origin chiefly to the palace, and is a quiet place, with broad, clean streets. Pop. 14,700. The castle or palace of Fontainebleau is one of the most magnificent in France. It occupies the site of a fortified château founded by Louis VII in 1162; this was converted into a magnificent palace by Francis I; much added to by Henry IV, Napoleon I, Louis Philippe, and Napoleon III. The palace was the residence of Madame de Montespan, Madame de Pompadour, and Marie Antoinette, and it was here that Napoleon I signed his abdication. The park is laid out like a vast garden, and adorned with statues, temples, fountains, lakes, and waterfalls. The forest, which is about 50 miles in circumference, covers an area of 42,500 acres, affords numerous pleasant walks, and abounds with game.

Fonta'na, Domenico, Italian architect and engineer, born in 1543, died 1607. He was employed by Pope Sixtus V in many great works, among the chief of which was the erection of the Egyptian obelisk in front of St. Peter's. Among other buildings erected by Fontana were the Lateran Palace and the library of the Vatican. He also executed important works at Naples.

Fontana, Prospero, Italian painter, born at Bologna 1512, died there 1597. He modelled his style mainly on Giorgio Vasari, especially in his decorative historical work at Rome, Fontainebleau, Genoa, and Bologna. He also painted many portraits. Among his pupils were his daughter Lavinia (born 1552, died 1614), whose best work is in portraiture, and the brothers Caracci.

Fontenay - le - Comte (font-nâ-lè-kônt), a French town, department of Vendée, N.E. 27 miles of La Rochelle. It has a fine church with Gothic spire 311 feet high; manufactures coarse linen and woollen cloths, and is an entrepôt for the Gironde and Charente wines. Pop. 10,379.

Fontenelle (font-nâl), Bernard le Bovier de, French author, born at Rouen 1657, died 1757. In 1674 he went to Paris, and soon became known by his precocious talents and versatility. Before the age of twenty he had assisted in the composition of the operas of *Psyche* and *Bellerophon*, which appeared under the name of his uncle, Thomas Corneille. In 1681 he brought out his tragedy *Aspar*; but it and the other dramas and pastorals with which he opened his literary career were on the whole unsuccessful. In 1683 appeared his *Dialogues of the Dead*, which were favourably received. His *Discourse on the Plurality of Worlds* (1686) was the first book in which astronomical subjects were discussed in a popular style. Among his other works are the *History of Oracles* and an *Essay on the Geometry of the Infinite*.

Fontenoy, a village in Belgium, province of Hainaut, celebrated for the battle of 11th May, 1745, in which the French under Marshal Saxe defeated the British, Austrian, and Dutch allied forces under the Duke of Cumberland.

Fontevrault (fon-tè-vrô), a village of N.W. France, department of Maine-et-Loire, in a valley 10 miles south-east of Saumur. Here was formerly a rich Benedictine abbey (now a prison) founded by Robert d'Arbrissel in 1099, containing both monks and nuns, and governed by an abbess. The abbey became the head of an order, and had many dependencies. The old monastic buildings, covering from 40 to 50 acres, are now used as a central prison. The abbey church contained the tombs of several of the Plantagenet kings; and there are still the effigies of Henry II and of Richard I, Kings of England and Counts of Anjou, of Eleanor, wife of Henry II, and Isabella, wife of John, King of England.

Foo-chow, a town of China, capital of the province of Fokien, on the Min, 125 miles N.E. of Amoy. It consists of the town proper, surrounded by walls, and of extensive suburbs stretching along both sides of the river, and communicating by a stone bridge. Foo-chow was one of the five ports thrown open by the

Treaty of 1843. The trade is very extensive, but the navigation of the river from the sea to the harbour is difficult. The town was bombarded by the French in 1884. It has a large arsenal and dockyard superintended by European officers; it is also a great literary centre. Pop. estimated at 624,000.

Food-control. The control of the supply and consumption of food-stuffs during the war from 1914 to 1918 was one of the gravest problems which the Governments of the European belligerent countries had to face. The food-stuffs chiefly concerned were bread, sugar, meat, and butter and margarine. Of these only sugar was rationed in every European belligerent country, but in nearly every country three out of the four groups of food—if not all—were rationed to the inhabitants. The earliest step taken in the United Kingdom in the direction of food-control was the appointment of a Royal Commission on Sugar Supplies, which was set up in Aug., 1914. A Royal Commission on Wheat Supplies was set up in Oct., 1916. In their early stages both these Commissions confined themselves to regulating the wholesale purchase and distribution of wheat and sugar respectively, but they played a prominent part in the stricter control which followed the establishment of the Ministry of Food. Both bodies later became international in character, and bought for the European Allies, and in the case of the Wheat Commission also for some neutrals as well as the British Government. So far as the consumption of food-stuffs by the population was concerned, economy was for some time enforced in the United Kingdom, as in the United States, by appeals for voluntary abstention, but in the United Kingdom the disturbing forces which had come to operate on the country's food-supply began to make themselves acutely felt towards the end of 1917, as a result of the shortage of shipping caused by the submarine campaign, and of the need for a reduction of the amounts spent in the purchase of food-stuffs abroad. Accordingly, first sugar and then meat and butter were 'rationed', i.e. the amount of each food which might be consumed in a week by each inhabitant was fixed, and the purchase of supplies above this amount was prevented by war-time legislation enforcing the presentation of a 'coupon' from a 'ration-book', covering a period of several months, on each occasion when supplies were purchased. The quantities of food allowed were varied in the case of heavy workers and of invalids. In the case of bread, compulsory rationing was not resorted to, but the normal worker not engaged on heavy labour was urged not to eat more than four pounds a week, and economy was secured by milling of wheat to a higher extraction of flour, by increasing

the admixture of other cereals, and to some extent by the importing of flour instead of wheat. The introduction of rationing (whether compulsory or voluntary, for in the case of bread the voluntary limit was generally observed) made possible an equitable division among the whole population of the limited supplies available, and also steadied prices. The period preceding rationing had been marked by a rapid rise in prices, and also by local panics due to temporary exhaustion of supplies in particular districts. These panics manifested themselves in 'queues' of purchasers, generally women of the working-classes, who gathered at shops which were rumoured to have supplies of the food-stuffs which it was difficult to obtain.

The administration of food-control for the whole country was in the hands of the Ministry of Food, a department created in 1917 which continued in existence till March, 1921, when its surviving functions were transferred to the Board of Trade. The first Food Controller was Lord Devonport, but the greater part of the ministry's constructive work was carried out under Lord Rhondda. The local administration was in the hands of Local Food Committees in cities, towns, and rural areas, under the direction of fifteen Commissioners, who represented the Food Controller in divisions comprising a number of counties. The Ministry of Food did not confine itself to dealing with food-stuffs the supplies of which were rationed, but also controlled the distribution of many other kinds of food-stuffs to retailers, with a view to watching the situation and being prepared to ration if occasion arose. Further important economy, both in shipping-space and in finance, was effected by centralizing in the hands of the ministry the purchase abroad and importation of a number of food-stuffs.

As the difficulties became more severe, steps were taken in 1918 to develop a system of inter-allied organization of food-supply, and accordingly food-control also had extensive international ramifications. In the case of a number of important food-stuffs, such as meat and fats, oil and seeds, as well as wheat and sugar, all purchases on behalf of the Allies were jointly determined by a single body in London, and carried out by a single body in the country in which purchases were made. Among the articles thus dealt with were meat, bacon, hams, lard, butter, poultry, fruit and vegetables, condensed milk, oleo oil and stock oil, margarine oleo and stearine, wheat, and sugar. The results of these methods were far-reaching, as they undoubtedly kept prices down by eliminating competitive buying by the European Allies in the United States, South America, and elsewhere, and at the same time rendered possible the most effective use of shipping, both by the most economical

routing of vessels bringing food-stuffs to Europe, and by the rationing of each of the Allies, so that as large a quantity of tonnage as possible might be diverted to the carriage of munitions of war.

Foods and Food Values. One of the most significant events that marked the separation of the ancestors of man from those of the apes was a tremendous change in diet. Although the apes and the lowlier Primates often eat eggs, grubs, and a variety of insects, or even small birds and reptiles, their diet is mainly vegetarian. But the human family is omnivorous. Mankind makes use of an infinitely more varied vegetable diet than the apes rely upon, but in addition it exploits almost every class of the animal kingdom for meat. Lowly races like the aboriginal Australians eat a variety of seeds and roots, but their diet is varied by shell-fish, fish, grubs, lizards, snakes, birds, and mammals. The earliest members of the human family of whose habits we know anything seem to have hunted wild cattle and horses, no doubt to obtain meat. But they also showed a partiality for coasts and river banks, and the great piles of shells (kitchen middens) and the number of harpoons found in association with the earliest known members of the species *Homo sapiens* reveal the important part oysters and other molluscs and fish played in the dietary of early man.

Civilization can be said to have had its origin when man began to cultivate barley and millet. At about the same time, and probably by the same people, cow's milk and butter were added to the diet. As culture spread in the region of the Eastern Mediterranean, wheat was added, and in India the methods of cultivating barley and wheat in Egypt and Mesopotamia were applied to the cultivation of rice. As culture spread, the diet of the people living in the centre of civilization became more and more varied as new kinds of food were brought in from the periphery. Hence at the present day the food of any civilized community includes a bewildering assortment of animal and vegetable products, as well as not a few synthetic substances made by chemists. In spite of this illimitable variety and complexity in the materials man uses for food, the essential ingredients are virtually restricted to the three categories, proteins, fats, and carbohydrates, with, of course, a necessary addition of water and certain inorganic salts. To test the value of any food-material the relative amounts of these three classes of substances must first be determined.

The usefulness of any of these substances is measured by its potential energy, by which is meant the amount of energy which can be obtained, either in the form of work, heat, &c.,

by the oxidation of the food-stuffs to the same extent as occurs in the living body, where the materials supplied to the body as food are in part absorbed and assimilated into the substance of the body and in part rejected (along with the waste products resulting from the bodily metabolism) as the excreta. In order to express in figures the total potential energy of a food-stuff, the term *calories* has been adopted. By burning a weighed quantity of dried food-stuff in oxygen in a calorimeter, the heat-value of any given food can be obtained and expressed as the amount of large calories given out by the substance on complete combustion with oxygen. A *large calorie* signifies the heat required to raise the temperature of a kilogram of water from 0° C. to 1° C. As illustrations of the value of common articles of food the following examples may be given: cane sugar 4·116, starch 4·191, lean meat 5·656, and butter 9·231.

But there are great differences in the case of different foods between the absolute heat-value (as tested in a calorimeter) and the physiological heat-value (as expressed in the living body of a human being). Some of the food-materials, like the carbohydrates (sugars and starches) and the fats, are completely oxidized in the body and ultimately converted into water and carbonic acid, so that their absolute heat-values are available and become expressed in work and heat in the body. But the protein foods (meat and certain parts of vegetable food) do not undergo complete oxidation in the body. There is only a partial oxidation, so that, instead of free nitrogen being given off (as it is when protein is heated in a calorimeter), in the living body the nitrogen is excreted as urea and other relatively complex bodies. Hence it is necessary to estimate the heat-values of such substances, and subtract the figures from the absolute heat-values of proteins, to obtain the physiological heat-value, i.e. the actual usefulness of these foods to the living body.

After making these necessary corrections the average physiological value of the three classes of food-stuffs can be expressed as follows:

- 1 gramme of fat = 9·3 calories.
- 1 gramme of carbohydrate = 4·1 calories.
- 1 gramme of protein = 4·1 calories.

“The average starvation metabolism of a vigorous man at light work and weighing 70 kilograms approximates 2240 calories, or 32 calories per kilogram. It is obvious that this amount of energy must be contained in the daily food, and a little more to counterbalance the ‘specific dynamic’ or heat-increasing power of the food-stuffs, if the individual is to be maintained in calorific equilibrium. When an average

mixed diet is ingested, the maintenance requirement is between 11.1 and 14.4 per cent above the starvation minimum. This would amount to from 2488 to 2502 calories, or from 35.5 to 36.6 calories per kilogram of body weight" (Lusk).

Sufficient food must be taken to supply these minimum requirements; but it is clear that the number of calories to be supplied will vary not only with the size of the body but also with the kind and amount of work done. While a small body requires fewer calories than a large, owing to the *relatively* greater extent of skin-area in the former, the number of calories per body weight is greater. An illustration taken from

The required number of calories can be provided by proteins, fats, or carbohydrates; but for several reasons it is important that all three kinds of food-stuffs should be included in the diet, and combined in proper proportions to form a satisfactory ration. A proper ration has been defined by Voit as "a well-tasting mixture of food-stuffs in proper quantity and in such a proportion as will least burden the organism" (Lusk). He gives the following ration of food administered in a digestible form for the use of an average labourer working from eight to ten hours a day: protein, 118 grammes; carbohydrates, 500 grammes; fat, 56 grammes. This represents 3055 calories.

	Weight (ounces).	Protein (grammes).	Fat (grammes).	Carbo-hydrate (grammes).	Calorific Value.
Fresh meat (with 20 per cent bone)	9.6	32.24	39.42	—	497
Meat, preserved	3.5	25.55	20.04	—	290
Bread	15	34.02	2.12	212.7	1031
Biscuit	4	18.82	1.67	90.34	463
Cheese	2	15.1	18.4	14	233
Butter	1	36	23.24	—	217
Condensed milk (1 tin for 12 men)	—	3.31	3.12	20.86	126
Bacon (waste 8.7 per cent) ..	4	10.85	60.53	—	606
M. and V. ration	5.5	18.28	20.86	9.12	304
Vegetables (fresh potato) ..	8	4.08	22	33.34	155
Sugar	3	—	—	76.55	313
Jam	3	—	—	52.3	214
Mustard	50	—	—	—	—
Pepper	30	—	—	—	—
Salt	12	—	—	—	—
Tea	8	—	—	—	—
	58.6	162.61	189.62	495.35	4440

Rubner (quoted by Lusk) will make this more intelligible.

Weight in Kgm.	Area in Sq. M.	Calories of Metabolism.	Calories per Kgm.
80	2.283	2864	35.8
70	2.088	2631	37.6
60	1.885	2368	39.5
50	1.670	2102	42.0
40	1.438	1810	45.2

A great deal of discussion has taken place with reference to a proper dietary, and much important work on the subject was done during the European War. The British field-service ration in June, 1916, was as above.

	Protein.	Fat.	Carbo-hydrate.
Actual proportion ..	1.0	1.16	3.05
Theoretical requirements	1.0	1.5	3.5

For purposes of comparison the following ration values in calories for different armies are given:

	British.	U.S.A.	Russian.	French.	German.
Peace Ration ..	—	4179	4060	3426	3161
Field Service Ration	4440	4199	4891	3064	2801
Emergency Ration	2595	4110	—	2130	2786

The following figures are given in an official British document:

Calories required per diem

For sedentary life	2450
„ slight muscular work	2700
„ light to moderate work	3050
„ moderate work	3400
„ very hard work	5500

One of the most important advances in the scientific understanding of the problems of nutrition has been the recognition of the fact that a proper diet to maintain the growth and healthy metabolism of the body must contain something more than proteins, fats, carbohydrates, and salts. "There are some substances existing in natural foods, in very minute quantities, which are absolutely essential to the harmonious fulfilment of the life processes" (Lusk). Funk gave the name 'vitamins' (generally written 'vitamines') to these substances. Writing in 1906, Professor Gowland Hopkins, of the University of Cambridge, who is one of the pioneers in this far-reaching advance in our knowledge, explained the significance of what he called the 'accessory factors' of diet. "No animal can live on a mixture of pure protein, fat, and carbohydrate, and even when the necessary inorganic material is carefully supplied the animal still cannot flourish. The animal is adjusted to live either on plant tissues or the tissues of other animals, and these contain countless substances other than proteins, carbohydrates, and fats."

The lack or insufficiency of these important materials in the food can cause such diseases as rickets, scurvy, pellagra, beri-beri, and other so-called 'deficiency diseases'. These vitamins have been differentiated into the 'fat-soluble A' and the 'water-soluble B'. The latter is regarded as identical with Funk's 'vitamins'. It cures the disease beri-beri.

Under the normal conditions of life human beings are constantly ingesting in fresh vegetable and animal food an adequate supply of these essential vitamins. But when such fresh foods are lacking and reliance is placed solely on tinned food or on cereals completely deprived of their pericarps, 'deficiency diseases' are apt to occur.

The epoch-making discovery of vitamins has given a fresh impetus to the scientific study of food, and at the present time intensive investigations are being made into the complex and many-sided problems relating to this subject.—Cf. Graham Lusk, *The Elements of the Science of Nutrition* (3rd edition, 1917).

Food-supply. Of the four chief manufacturing and commercial countries, Britain, Germany, France, and the United States, only the

last is practically self-supportive in respect of food-supply, but even in this case there is a considerable importation of sugar, coffee, and tea. The other three countries are all more or less dependent upon importation for some essential elements in their food-supply, and this dependence upon other lands is most marked in the case of Britain. Before the European War the United Kingdom imported annually food and drink to the value of no less than £230,000,000 (roughly speaking), which was fully two-fifths of the total value of her whole annual import trade. Her annual import of grain and flour alone was valued at over £70,000,000, more than half of this representing wheat, wheat-meal, and flour. In the five years 1910–4 the United Kingdom imported 80 per cent of its wheat and wheat-flour, as well as large quantities of oats, barley, and maize; altogether of the total cereal requirements of the country over 60 per cent were imported during that period. This dependence has been widely regarded in recent years as a serious weakness in Britain's economic and strategical position, and various proposals have been made for diminishing or removing it. Some are of opinion that Britain can obtain the whole of her food-supply from within the empire, and advocate the adoption of fiscal arrangements intended to bring about this state of imperial self-sufficiency. Others maintain that the empire cannot, at least for a very long time, supply the needs of the mother country in regard to food out of its surplus production, and hold that all the definite plans of imperial preference and reciprocity that have actually been proposed would entail serious economic evils out of all proportion to any benefits which might follow from their adoption. Others, now comparatively few, seek to return to the old agricultural protectionism in order to increase the agricultural output of the United Kingdom, and still others hope for a revival of British agriculture from a radical reform of the land system, such as would give greater freedom and security to the farmer, a more honourable and independent position to the labourer, and a more effective co-ordinating control to public authorities.

In view of the special importance of the food-supplies of the country in time of war, a Royal Commission was appointed in 1903 "to inquire into the conditions affecting the importation of food and raw material into the United Kingdom in time of war, and into the amount of the reserves of such supplies existing in the country at any given period, and to advise whether it is desirable to adopt any measures, in addition to the maintenance of a strong fleet, by which such supplies can be better secured, and violent fluctuations avoided". The Commissioners, who reported in 1905, assumed that the stock of

wheat in the United Kingdom, which was usually about 17 weeks' supply in September, would never fall below 7 weeks' supply except in August, when it might be 6½ weeks. They held that "not only is there no risk of a total cessation of our supplies, but no reasonable probability of serious interference with them, and during a maritime war there will be no material diminution in their volume". They considered various schemes for preventing the dangers that might accrue from a 'panic' rise of prices during wartime, and held that a large stock of grain existing within the United Kingdom would be the most powerful means of attaining this end, but they felt bound to reject nearly all the proposed schemes for increasing the stock of grain. They strongly approved the introduction of a system of national indemnity against loss from capture by the enemy, on the ground that it would operate as an additional security to the maintenance of our overseas trade and as an important steadying influence upon prices.

The conclusions of the Royal Commission were confirmed by experience in the European War (1914-8), as food-stuffs flowed freely into this country from its numerous sources of supply overseas. It was not until 1916 that the need for economy of purchases abroad, and the shortage of shipping due to other demands and to submarines, caused the Government to encourage tillage by guaranteeing the prices of wheat, oats, and potatoes. In 1917 the position became more serious as the result of unrestricted submarine warfare, and the Corn Production Act was passed. This secured to the farmer minimum prices for wheat and oats over a period of five years; gave the agricultural labourer a minimum wage fixed by agricultural wages boards; and gave the Board of Agriculture powers of entry on land and of requiring better cultivation. About the same time a special Food Production Department of the Board of Agriculture was set up, whose functions were to secure an adequate supply of labour for agriculture; to mobilize and increase the supply of horses and agricultural machinery; and to arrange the supply and distribution of seed and fertilizers. The department worked largely through county and local agricultural committees, and some idea of its work is given by the fact that the number of women working on the land was increased from ninety to three hundred thousand, and that over four thousand tractors were made available for ploughing, &c., while the tillage area was increased by three million acres between 1916 and 1918. As a result, it was possible very largely to reduce the quantity of cereals imported. After the close of the war, however, the amount of land under crops speedily fell again, and the question arose whether, and if so what, steps should be

taken permanently to increase the proportion of food-stuffs consumed in the United Kingdom which is produced at home. In 1920 the Agriculture Act was passed, the first part of which continued the system of guaranteed prices, minimum wages, and enforcement of good cultivation which had been instituted as a wartime measure by the Corn Production Act, 1917. In 1921, however, the collapse of cereal prices threatened to involve the Government in very heavy expenditure to maintain guaranteed prices to British farmers, and accordingly the first part of the Agriculture Act was repealed, which involved a return to pre-war conditions as regards food production in the United Kingdom.

Fools, Feast of, the name given to festivals regularly celebrated, from the fifth to the sixteenth century, in several countries of Europe, by the clergy and laity, with the most absurd ceremonies. The Feast of Fools was an imitation of the Roman Saturnalia, and, like this, was celebrated in December. The chief celebration fell upon the day of the Innocents, or upon New Year's Day; but the feast continued from Christmas to the last Sunday of Epiphany. The young people, who played the chief parts, chose from among their own number a mock pope, archbishop, bishop, or abbot, and consecrated him, with many ridiculous ceremonies, in the chief church of the place. They often travestied the performance of the highest offices of the Church, while others, dressed in different kinds of masks and disguises, engaged in indecent songs and dances, and practised all possible follies in the church. Except from their association with the Saturnalia, nothing is known of the origin of these extravagancies, which appear to have been very ancient. They were most common in France, but the feast was also observed in Spain, Germany, England, and Scotland. In France it survived till the year 1644. —Cf. Du Tilliot, *Mémoires pour servir à l'histoire de la fête des fous*.

Foolscap, paper of the smallest regular size but one (about 13½ by 16½ inches); so called from its watermark in early times being the outline of a fool's head and cap, for which British paper-makers now substitute the figure of Britannia.

Fool's Parsley, the popular name of *Aethusa Cynapium*, nat. ord. Umbelliferae, a common British weed, growing in cultivated grounds. It is commonly believed to be poisonous, and serious accidents are said to have occurred from its being mistaken for parsley; but if poisonous, it is so only in certain localities. Its unilateral reflexed floral leaves distinguish it from most plants to which it is allied.

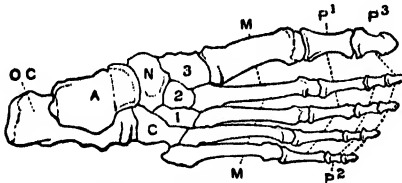
Foo-shan, a town, China, province of Quang-tong, 21 miles s.w. of Canton, on one of the

branches of the delta of the Si-kiang. Pop. 200,000.

Foot, a measure of length, the name of which is derived from the length of the human foot, containing 12 linear inches.—*Square foot* is a square whose side is 1 foot, and is therefore equal to 144 sq. inches.—*Cubic foot* is a cube whose side is 1 foot, and the cube contains 1728 cubic inches. The foot is a common measure in various countries, but its dimensions vary considerably.

Foot, in prosody, a measure consisting of a variety of syllables, two, three, or four, in combinations of long and short, or accented and unaccented. In Greek and Latin verse the feet depend on the *quantity* or length of the syllables, each foot having a distinctive name—*trochee*, *iambus*, *dactyl*, *anapaest*, &c. The same names are applied to English measures, an accented syllable in English being held to be equivalent to a long syllable in Latin or Greek, and an unaccented syllable to a short.

Foot, in animals, the lower extremity of the leg; the part of the leg which treads the earth



Skeleton of the Human Foot

OC, Os calcis or heel-bone. A, Astragalus. N, Navicular or scaphoid. C, Cuboid. 1, 2, and 3, External, middle, and internal cuneiform. M, Metatarsal bones. P₁-P₃, Three rows of Phalanges.

in standing or walking, and by which the animal is sustained and enabled to step; or that surface of the body by which progression is effected among the mollusca. The foot of man is composed of twenty-six bones, seven of which constitute the tarsus or ankle, which articulates with the leg and corresponds to the carpus (wrist). Five bones form the metatarsus, which corresponds to the metacarpus, and articulates with the tarsus behind, and with the toes in front. The foot is narrow and thick in its posterior part, thinner and broader anteriorly; it forms a right angle with the leg, and rests upon the ground at the extremities only. The middle portion is in the form of an arch, and, in consequence, resists shocks and supports pressure much better than it could if it were flat and touched the ground throughout its whole length.

Foota-jallon, or **Futa-jallon**, a large district forming the inland portion of French Guinea; area, 40,000 sq. miles; pop. about 600,000. It

is extremely mountainous, and is the source of the Rivers Senegal, Gambia, and Grande. Large herds and flocks are pastured in the highlands; and the soil produces in abundance oranges and bananas, and palm trees, which furnish dates, wine, and oil.

Foot-and-mouth Disease, a highly contagious cezematous affection which attacks the feet and mouths of cattle, manifesting itself by lameness, indisposition to eat, and general febrile symptoms, with ultimately eruptions of small vesicles on the parts affected, and general indisposition of the animal. The disease occasionally spreads to the udder of milch-cattle, and it is believed that it may be communicated to persons who drink the milk of cows so affected.

Football, a game which, as the name implies, consists in imparting motion to a ball with the feet. The extreme simplicity of materials required explains the great antiquity (and now-days remarkable popularity) of the game. In some form or other it existed beyond doubt among the Greeks, and evidence is available that the form then in vogue bore some resemblance to the present Rugby form, since, in addition to kicking, the ball was held in the hand. The game was introduced into this country by the Romans, and for long it maintained a doubtful popularity, principally on account of the roughness of the methods, an objection which induced James I to forbid the heir-apparent to play. No definite rules appear to have been formulated until Rugby school-boys drew up a code for themselves, and a classical description of the game then played is familiar to readers of *Tom Brown's Schooldays*. Up till then, and indeed at that time, the system of limiting the number of players on the opposing sides had not been adopted. Provided that opposition was afforded, no other distinction appeared necessary, and even to this day, in various parts of the country, Shrove Tuesday remains the football day of the year, when the whole of a small town or district engage in a contest unlimited as to the number of participants, the field of play, and the duration of the game. Such an annual game is, of course, only a traditional persistence, and at the present, wherever football is played, a number of rules govern the players' methods according to the code—Rugby or Association.

To conclude the historical survey. It has been mentioned that Rugby School developed a game with the first definite rules, constituting the basis of Rugby football as we know it to-day. It appears that during the course of a game one enterprising player spontaneously introduced the innovation of taking the ball in his hand and running with it, an innovation suggesting such desirable possibilities that Rugby football soon

came into being. So that, although the first of the two codes to be played under proper rules, it was actually a modification of a game of genuine football which had been in existence for centuries. Apart from the school, the game received little support until the middle of the nineteenth century. It was still unattractively rough; actually the system of hacking an opponent was not forbidden until 1877. Other schools, however, gradually followed, and clubs came into existence, but a want of uniformity proved a great disadvantage until the establishment of the English Union in 1871, followed by the International Board in 1889 to settle any disputes which inevitably arose, since various unions adopted rules of their own not accepted by their opponents. Even at the present day the Northern Union has remained separate from all others, with a number of minor distinctions in its rules, and the important difference that its players may be financially subsidized. Outside the Northern Union there is no professional Rugby football, a very striking contrast, as will shortly be shown, to Association football.

Rugby Football is played between sides of fifteen, and the usual arrangement is to divide them into eight forwards, two half-backs, four three-quarter backs, and one full back. Rigidity as to this formation is not essential. There has of recent date been a tendency to reduce the number of forwards to seven, and increase the three-quarter back-line, or, as is the case among the South African players, to modify the construction of the team so as to present seven forwards, two half-backs, two 'five-eighths', three three-quarter backs, and a full back. The opposing captains toss a coin for choice of position, the advantage afforded by the prevailing wind and slope of the ground, and, to a lesser degree, by the sun, dictating the selection, although, as the teams change ends at half-time, the captain successful in the toss must exercise some judgment in selecting the period of the game in which he will employ the advantage of the better position.

The details of the game and the rules which govern it are far too numerous to describe, but the essential feature is to score goals by kicking the ball *over* the cross-bar of the opposing side, with the alternative of carrying the ball over the line behind the goal-post and touching it down, thus scoring 'a try', which carries with it the privilege of attempting to kick a goal from a point reached by proceeding directly backwards from the position where the try was scored to an arbitrary distance, at the discretion of the player who attempts the kick. It is obvious that the nearer to the goal the try was scored, the easier it will be to kick a goal,

since very much greater skill will be required to kick a goal at an acute angle, which will be necessary if the ball has been touched down near the touch-line. It remains to be added that the try in itself ('unconverted') scores a smaller number of points, so that the game is won according to the total points—goals and tries—scored. A goal may also be kicked not from a fixed place, but as a 'drop-kick' from any part of the field. Essential rules of the game are that a player who is not at the time holding the ball may not be molested, and that even when in possession of the ball, although he may be 'tackled' or 'collared' to prevent his proceeding farther or from passing the ball to one of his colleagues, he may not be tripped up. If such fouling occurs, the side is penalized by giving their opponents an opportunity to kick a goal, or at any rate to improve their position in the field of play by a kick forwards. The ball may be 'passed', that is, thrown or kicked to a colleague, but always in a backward direction. And finally, should a player kick the ball forward, it may not be touched by any other player of his side until (1) a player of the other side has touched it, or (2) unless he was behind the player who kicked it at the moment when the kick took place. This is known as the 'off-side' rule.

The game is started by the ball being kicked from the centre of the field by a member of the team that lost the toss for choice of ends. Subsequent occurrences depend upon the skill of the opposing sides. The idea, as has been stated, is to carry the ball across the goal-line of the other side, and this is achieved by running, dodging, and swerving, and passing to a colleague at the critical moment, drawing the opposition, perhaps, so that he has a clear run at the time when he receives 'the pass'.

The three-quarter backs are essentially the players who are expected to score in this way. It may be crudely said that the forwards open up the game as a whole, the half-backs develop the game and get the ball for their three-quarters, whilst the *métier* of the full back is defence, so that he is usually selected for his strength in tackling and his powers in long-distance kicking. The three-quarter backs should combine speed with skill; they should be able to get into their stride with the minimum of delay, to swerve at speed, and yet be strong enough to 'hand-off' opponents who endeavour to stay their progress, and to break up the combination of the opposing three-quarter line. It will be readily believed that a player who unites all these attributes is not often obtainable, and a compromise in selection is inevitable. Many Rugby football players of great pace have been far inferior to less speedy runners who had a

better general conception of the game and were more clever in their tactics.

The duration of the game is from an hour to an hour and a half, divided into two equal periods of play, with a short interval at half-time, when the teams change ends.

Whilst the game is slowly increasing in popularity to the extent that it is being adopted by certain of the great public schools, e.g. Harrow, who have hitherto preferred the other code, it is certainly not the favourite of the masses. The great exponents of the Rugby game are the Scottish public schools, particularly Fettes, Loretto, and Glenalmond; English public schools, such as Bedford, Rugby, Uppingham, Dulwich, Merchant Taylors, St. Paul's, Oundle, The Leys, and Mill Hill; the hospitals, colleges, and universities throughout the British Isles; and a number of clubs in London, such as Blackheath, Richmond, and The Harlequins, who usually draw upon old public school and university players. In addition, many towns may be mentioned as the homes of Rugby football, e.g. Leicester, Gloucester, Coventry, Northampton, whilst the vogue in South Wales is greatest of all, so that even a comparatively small town has a first-class team, and the teams of the larger towns, such as Newport, Swansea, and Cardiff, challenge comparison with the best.

Association Football.—The Association code of football was originally devised in the old public schools. At Westminster School a form of football, suitable to the cloisters, was practised 200 years ago. Almost since the school's foundation football was played at Harrow. In greater or less degree matches were played among the boys at the schools of Shrewsbury, Charterhouse, Uppingham, Winchester, Eton, and Rugby. The area of the playing spaces, as well as the ideas of the masters and the pupils, produced different rules, which are set forth under such titles as "The Uppingham Game", "The Winchester Game", "The Rugby Game", and "The Eton Game" (in two styles). When the boys went to the universities, and into other spheres of life, they desired to continue such manly exercise, but the wide divergence of rules was a serious difficulty.

Obviously universal laws for the game were essential, and in 1863 an effort was made to obtain such uniformity by players in London and by a committee at Cambridge University. But on 26th Oct., 1863, the representatives of thirteen London clubs held a meeting and resolved: "That the clubs represented at this meeting now form themselves into an association, to be called the Football Association". The scheme of the promoters was to include the best points of all rules, and to bring all players into one body. They were not successful, for the Blackheath Club, adhering to the practice of

carrying the ball, withdrew, and the rules finally ratified on 8th Dec., 1863, were in principle, but not in detail, the same as those drawn up by Cambridge University. Thus there was a cleavage which has endured, the Football Association, the pioneer body of governing Associations, maintaining the control of the game, which for some years was chiefly confined to clubs formed by the former pupils of the public schools, and by middle-class men connected with the law and banking. Progress was slow, for at the beginning of 1866—7 only Barnes, Civil Service, Crystal Palace, Kensington School, London Scottish Rifles, the No Names, Royal Engineers, Sheffield, The Wanderers (all public school men), and Worlabyc House were affiliated to the Association. The game was popular in Sheffield, and the Sheffield club proposed a match between London and Sheffield. The game was played on 31st March, 1866, at Battersea Park—the first representative match. The game spread farther afield, and in July, 1867, the Queen's Park Football Club, Glasgow, was formed, having obtained a copy of the rules from Mr. John Lillywhite, of London, who had published them.

Clubs were organized at many centres, and in the last three months of 1867, 300 matches were played under the laws of the Association, compared with 122 for the same period in 1866—these figures being founded on reports in newspapers of the day. In 1870 Queen's Park became members of the Football Association, and sixteen clubs in Sheffield were affiliated. On 20th July, 1871, the Football Association resolved: "That it is desirable that a Challenge Cup should be established in connection with the Association for which all clubs should be invited to compete". This was carried into effect, and the £25 necessary for the purchase of the Challenge Cup (now known popularly as The English Cup) was subscribed by the clubs. Fifteen clubs, including Queen's Park, entered, and this competition not only brought the game into considerable popularity, but was the indirect means of bringing about the first match between England and Scotland on 30th Nov., 1872, at Partick, Glasgow. The Queen's Park arranged the match and supplied the team.

Between 1867 and the middle of the 'seventies various other organizing and controlling bodies came into existence. Clubs were formed in all parts of England and Scotland—provincial clubs which had their own county and district administrative executives, and these in turn became allied with national associations. Owing to the initiative of Queen's Park, the Scottish Football Association was founded on 13th March, 1873, and the pastime gained ground far more speedily in Scotland than in England. Thus in 1875 the Scottish Association had 27 clubs in membership; in 1876—7, 91 clubs; and in 1880, 140 clubs. The

Scottish Association in 1876-7 had an entry of 81 clubs for the Scottish Cup, while the parent Association in London had but 37. Scotland began a series of international matches with Wales at Glasgow in 1876, and after that encounter the Welsh Association was brought into being on 24th May, 1876. In 1878 Queen's Park and the Glasgow Caledonians played an exhibition game on the ground of the Ulster Cricket Club, at Belfast. Thus were the seeds of "the noxious Scottish weed" planted in Ireland, and in 1879 the Cliftonville Club was established. The example was followed, and the Irish Association was organized in Nov., 1880. With all Great Britain playing this game, the Association code was carried overseas, and became recognized throughout the world. The outcome of the foundation of these governing bodies in the British Isles was the International Board, which first met in London during June, 1887. This consisted of two representatives of each of the four national Associations, who discussed and decided "proposed alterations in the laws of the game, and generally any matters affecting Association football in its international relations". When the game extended to most parts of the world, an International Federation was established at Amsterdam, and this body was eventually permitted to send delegates to the International Board, which, however, maintained its power as the makers of the laws. As Great Britain eventually seceded from the Federation, the Board remains, as always, the supreme authority on the laws.

The spread of the game throughout the industrial centres of England, and the entrance of many ambitious clubs for the English Cup, brought in a democratic element. Eventually intense rivalry induced clubs to seek out capable players, without any local attachment, and make them members. Many men left Scotland for English clubs between 1880 and 1884. There was no doubt that these importations were secretly paid, and, after great arguments for a year or two, the Football Association, in the summer of 1885, made payments—which they were powerless to prevent—legal, and thus gave official sanction to professionalism. The Scottish Association published a list of 'outlaws', but in spite of that in 1890 there were 230 Scottish professionals in England. In May, 1893, the Scottish Association legalized payments to players, and other countries eventually accepted what was considered inevitable.

From 1885 there was thus a distinct division in English football, the players being classified as amateur and professional. The professional side of the game has become entirely spectacular, and has attracted more public attention, but there is far more amateur football. In order

to obtain money to pay wages, the big clubs in England met in April, 1888, and formed the Football League. This consisted of Preston North End, Wolverhampton Wanderers, Bolton Wanderers, Aston Villa, West Bromwich Albion, Everton, Derby County, Notts County, Burnley, Stoke, Accrington, and Blackburn Rovers. There were only five rules. The first bound the clubs not to cancel League Matches, and the third decreed that League Matches must be played in full strength.

This departure caused the institution of preliminary qualifying stages for national trophies, and the exemption of powerful clubs so that they could carry out their League programmes. The Football League gradually grew in importance, and in the season of 1921-2 had 86 clubs, in four sections, playing matches under its management. The League system has not only been of great value to clubs employing professionals, but has tended to the order and discipline of amateur clubs both in football and other sports. In 1890 the Scottish Football League was arranged, the clubs then consisting of the Heart of Midlothian (who took the first steps), Glasgow Rangers, Glasgow Celtic, Paisley St. Mirren, Third Lanark, Paisley Abercorn, Dumbarton, Cambuslang, Vale of Leven, and Cowairs. The Queen's Park, which has ever remained the most prominent amateur club in the world, declined an invitation to join the League, but in 1900-1, after holding out for ten years, Queen's Park joined the League, but preserved their Constitution, thus being the only amateur club associated with either the English or Scottish Leagues. A federation of eight clubs banded themselves together to make the Irish League in 1890-1, and for the season of 1921-2 the Welsh League, conceived on a national basis with northern and southern sections, commenced its operations. The pastime of the schools has become a highly organized spectacular sport provided by professionals, rigidly controlled by associations and leagues. With all this development of one side of the game, it should not be overlooked that in England, where there are 8000 registered professionals (the great majority being artisans attached to relatively small clubs), there are 800,000 amateurs. For every one professional there are 100 amateurs—a fact which is too often overlooked because the professionals' matches attract mammoth crowds, whereas the amateurs play for their own recreation and amusement, and not to entertain those who look on at games.—BIBLIOGRAPHY: K. R. G. Hunt, *Association Football*; J. E. Raphael, *Modern Rugby Football*; Sir Montague Shearman, W. J. Oakley, G. O. Smith, and Frank Mitchell, *Football* (Badminton Library); *Official Football Guide* (Spalding's Athletic Library); R. H. Barbour, *The Book of School and College Sports*.

Foote, Samuel, English comic writer and actor, born about 1720 at Truro, died at Dover 1777. He was educated at Oxford, and entered the Temple; but after a course of dissipation, to which his small fortune fell a sacrifice, he turned his attention to the stage. He appeared first in *Othello*, but had little success as a tragedian. In 1747 he opened the theatre in Haymarket with a dramatic piece which he entitled *The Diversions of the Morning*. It consisted of some very humorous imitations of well-known characters, in detached scenes, written by Foote, who always took the leading parts himself. After 1752 he performed alternately in London and Dublin. He did not obtain a patent for the Haymarket till 1766. Among his numerous plays, above twenty in number, are *The Liar*, *The Mayor of Garratt*, and *The Devil on Two Sticks*, but none are memorable. His humour is described by Dr. Johnson and other witnesses as irresistible.

Foot-pound, in physics, the practical unit measuring the work done by a mechanical force. A foot-pound represents the work done against gravity when 1 lb. weight is raised through a vertical height of 1 foot. See *Horse-power, Work*.

Foot-rot, a disease in the feet of sheep, the more common form of which is an inordinate growth of hoof, which at the toe, or round the margin, becomes turned down, cracked, or torn, thus affording lodgment for sand and dirt. In the second form of the disease the foot becomes hot, tender, and swollen; there are ulcerations between the toes, followed by the sprouting of proud flesh.

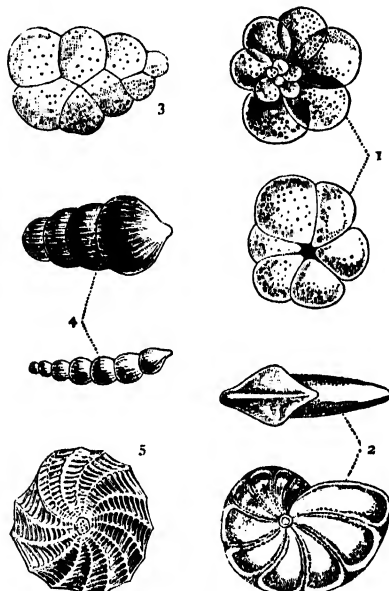
Foot's Cray, urban district or town of England, in Kent, on the River Cray, $5\frac{1}{2}$ miles S.S.E. of Woolwich. Since 1920 the official name of Foot's Cray is Sidcup. Pop. 8940.

Footstalk, (1) in botany, a petiole; the stalk supporting the leaf, or connecting it with the stem or branch. (2) In zoology, a process resembling the footstalk in botany, as the muscular process by which certain of the Brachiopoda are attached, the stem which bears the body in barnacles, the stalk which supports the eyes in certain crustaceans.

Forain, Jean Louis, French artist, born in 1852 at Rheims. He studied under Gérôme at the École des Beaux-Arts, and soon distinguished himself by his satirical talent and his humorous sketches. In 1876 he began to contribute his humorous sketches, wherein he castigated contemporary French life, to *La Cravache*, the *Figaro*, *Journal Amusant*, *Vie Parisienne*, and *Le Rire*, and to his own paper, *Psst*. In this sheet, founded by himself and Caran d'Ache in 1898, during the Dreyfus agitation, he expressed anti-Semitic sentiments.

Foraminifera, an order of animals of low

type belonging to the class Rhizopoda, phylum Protozoa, furnished with a shell or test, simple or complex, usually perforated by pores (*foramina*), whence the name. The shell may be composed of horny matter, or of carbonate of lime, secreted from the water in which they live. Owing to the resemblance of their convoluted chambered shells to those of the nautilus, they were at first reckoned among the most highly organized molluscs. In reality they are among the simplest of the protozoa. The body of the



Foraminifera (shells enlarged)

1, Globigerina. 2, Cristellaria. 3, Textularia.
4, Nodosaria. 5, Polystomella.

animal is composed of slimy protoplasm, which not only fills the shell, but passes through the perforations to the exterior, there giving off long thread-like processes called *pseudopodia* interlacing with one another so as to form a net like a spider's web. Internally the protoplasmic body exhibits no structure or definite organs of any kind, but several nuclei are present. Foraminifera appear very early in the geological formations. The great formation known as white chalk is largely composed of foraminiferous shells, while another remarkable formation known as Nummulitic Limestone receives its name from the presence of coin-shaped foraminifers, generally about as large as a shilling.

Forbes, Archibald, journalist and war correspondent, the son of a country minister in Scotland, was born in 1838, and died in 1900.

He received a university education at Aberdeen, served for some years in the Royal Dragoons, but gave up the army for journalism. As war correspondent of *The Daily News*, he was with the German army in 1870-1, subsequently visiting Paris at the time of the Commune, India during the 1874 famine, and Spain. During 1875 and 1876 he accompanied the Prince of Wales in his Indian tour, and was an eye-witness of the Serbian War of 1876, and the Russo-Turkish War of 1877, going to Cyprus in 1878. He was under fire during the Afghanistan campaign of 1878-9; next visited Mandalay, and accompanied Lord Chelmsford's army in Zululand, being the first to telegraph home news of the victory of Ulundi (1880). His health now began to break down, and he devoted himself chiefly to lecturing. His chief publications were: *My Experiences in the Franco-German War*; *Glimpses through the Cannon Smoke*; *Chinese Gordon*; *Souvenirs of Some Continents*; *William I of Germany*; *Barracks, Bivouacs, and Battles*; *Havlock*; *The Afghan Wars*; *Czar and Sultan*; *Colin Campbell, Lord Clyde*; *Memories and Studies of War and Peace*; and *Life of Napoleon III*.

Forbes (for'bes or forbz), Duncan, of Culloden, Scottish lawyer and politician, born 1685, died 1747. He studied law at Edinburgh and Leyden; was called to the Bar in 1709, and appointed Sheriff of Midlothian. He helped to crush the rebellion of 1715; in 1716 was Advocate-Depute, in 1722 member of Parliament for the Inverness Burghs, in 1725 Lord-Advocate, and in 1737 Lord-President of the Court of Session. In 1734, in consequence of the death of his brother, he fell heir to the estate of Culloden. He devoted himself to the improvement of the industry of Scotland, and materially aided in laying the foundations of that commercial prosperity to which his country has since attained. He also effected many improvements in the procedure of the Court of Session. It was mainly owing to his exertions that the rebellion of 1745 was prevented from spreading more rapidly among the clans; but so ungratefully was he treated by the Government, that he was never able to obtain repayment of the large sums he had expended to uphold it. He wrote several religious works: *Thoughts on Religion*, *Reflections on the Sources of Incredulity in Regard to Religion*, and *Letter to a Bishop*.

Forbes, Edward, British naturalist, was born at Douglas, Isle of Man, 1815, died at Edinburgh 1854. He early devoted himself to science, and having made scientific journeys in Norway, Sweden, France, and Germany, he was attached to a scientific expedition to the Mediterranean, the result of which appeared in a report presented to the British Association, and in *Travels in Lycia*. In 1842 he became professor of botany

at King's College, London. On the opening of the School of Mines Forbes was appointed lecturer on natural history as applied to geology and the arts. He still retained his professorship of botany at King's College, and continued to contribute annually some of his most valuable memoirs to the British Association, besides writing for scientific and literary journals. In 1853 he was appointed to the chair of natural history in Edinburgh. Among his more important works, which include a great number of valuable papers on zoological, botanical, and literary subjects, are a *History of the Star-fishes* and *History of British Mollusca*.

Forbes, Henry Ogg, Scottish naturalist and traveller, born in 1851, and educated at Aberdeen Grammar School and Aberdeen and Edinburgh Universities. He studied medicine for a time, and after two years' biological and geological investigations in Portugal (1875-7), he began in 1878 a six years' course of exploration in the islands of the East Indian Archipelago, where he made large collections and numerous observations, ethnological, biological, and geographical. Subsequently he led expeditions to explore Mount Owen Stanley, in New Guinea, and held the post of Acting Deputy-Commissioner in British New Guinea from 1886 to 1889. From 1890 to 1893 he was Director of the Canterbury (N.Z.) Museum, and in the latter year explored the Chatham Islands. He also explored the Island of Socotra (1898-9). His most important publication is *A Naturalist's Wanderings in the Eastern Archipelago*. Dr. Forbes was Director of Museums to the Corporation of Liverpool from 1894 to 1911. He is LL.D. of Aberdeen University and Fellow of the Royal Geographical Society. From 1917 to 1920 he was on the Council of the Royal Geographical Society, and from 1883 to 1917 a Fellow of the Royal Anthropological Institute, when he resigned his fellowship owing to the retention of enemy members.

Forbes, James David, Scottish scientist, born 1809, died 1868. He was educated at Edinburgh University, and admitted to the Scottish Bar. In 1833 he was appointed to the chair of natural philosophy in the University of Edinburgh. In 1860 he became principal of the United Colleges of St. Salvator and St. Leonard in the University of St. Andrews. His fame rests chiefly on his study of glaciers. His chief publications on this subject are: *Travels through the Alps of Savoy, Norway and its Glaciers*, *Tour of Mont Blanc and Monte Rosa*, and *Occasional Papers on the Theory of Glaciers*. Forbes's theory of the glacier was that it was a viscous body, urged down slopes of a certain inclination by the mutual pressure of its parts.

Forbes, Sir John, a Scottish physician, a

homœopathist, phrenologist, and believer in mesmerism, born 1787, died 1861. He received his professional education at Aberdeen and Edinburgh, graduating M.D. at the latter in 1817. In 1840 he settled in London, and soon became physician extraordinary to the Prince Consort, and physician to the queen. In 1853 he was knighted. His first works were his translations of the writings of Avenbrugger and Laennec on auscultation and the use of the stethoscope. To the *Cyclopædia of Practical Medicine*, of which he was joint-editor with Drs. Tweedie and Conolly, he contributed some of the best articles in the work. He was the founder of the *British and Foreign Medical Review*, and published a number of professional and other works.

Forbes MacKenzie Act, the popular title of an Act for the better regulation of the public-houses of Scotland, passed 15th Aug., 1853. It was introduced in the House of Commons by Forbes MacKenzie, member for Liverpool, although its author was Lord Kinnaird. See *Licence*.

Forbes-Robertson, Sir Johnston, British actor, born in London in 1853. Educated at the Charterhouse, he studied art at the Royal Academy School, and elocution under Samuel Phelps, making his first appearance on the stage in 1874. He soon became one of the foremost actors of his time. Among the plays wherein he obtained great success were: *For the Crown* (1896), *Mice and Men* (1902), *The Light that Failed* (1903), and *The Passing of the Third Floor Back*. Among his Shakespearean rôles are Hamlet, Othello, Shylock, and Macbeth. He married Gertrude Elliot, the actress, in 1900, and was knighted in 1913 at the termination of his farewell season at Drury Lane.

Forbidden Fruit, a name fancifully given to the fruits of various trees grown in tropical countries, as the shaddock (*Citrus decumana*), a sort of thick-skinned orange (*Citrus paradisi*), and the poisonous fruit of the *Tabernaemontana dichotoma*, a tree of Ceylon, traditionally said to be the fruit of which Adam and Eve ate at the time of the fall in Eden. According to Mohammedan theologians, however, the fruit eaten by Adam and Eve was not the apple, but the banana or Indian fig.

Forcados, a seaport of Southern Nigeria, on the west coast, on the south shore of the estuary of the River Forcados. Owing to the presence of a sand-bar at the entrance to the harbour of Lagos, cargo-vessels proceed to Forcados, where they unload, and the goods are transhipped in smaller vessels, which are able to cross the bar at Lagos. Forcados carries on a large proportion of the trade of Southern Nigeria, and is also a port for Northern Nigeria.

Force, in a general sense, is any cause of

physical action. In the special sense of ordinary dynamics (q.v.), force means that which changes or tends to change the motion of matter. More definitely, according to Newton's second law of motion, a force is measured by the momentum (product of mass and velocity) which it produces in a body in the unit of time. By Newton's laws, the force acting on any body, or on any particle of the body, can be calculated when the motion is known. Some writers regard force as simply a name for the result of this calculation, and maintain that we ought to think and speak of what we directly observe, which is not force, but mass-acceleration or rate of change of momentum. As against this view other authorities point out that in some cases we perceive force directly by our muscular sense, so that it ought to be considered to have a real physical existence. When, for example, a man holds a weight above the ground, it would certainly seem more natural and convenient to describe what is happening to the man and to the weight in terms of force than in terms of motions which have only a hypothetical existence.

A force can be represented graphically by a straight line, which indicates its position, direction, and magnitude. Since the force may act either backwards or forwards along the given line, an arrow-head is usually added to make the specification complete. A force may be either a tension or a pressure, in other words, a pull or a push; but the distinction between the two types only becomes important when we take elastic properties into account. The conception of a single force acting along a mathematical straight line is of course only a convenient abstraction. What we have in nature is always a more or less continuous distribution of force, either throughout a volume, like weight, or over an area, like the pressure of the atmosphere. See *Electromotive Force*; *Magnetomotive Force*; also references under *Dynamics*.

Forced Draught, in steam-boiler practice. In many circumstances it is impossible to use a chimney sufficiently high to carry away the products of combustion which are formed in the firing of a boiler. For instance, in ships the height of the funnel is limited, and in very large land boilers the quantity of flue gases to be got rid of is very large. In such circumstances the flue gases are either forced up the chimney or they are sucked out of the furnace by fans placed in the path of the gases. The former system, in which air enters the boiler at a pressure higher than that of the atmosphere, is called the *forced-draught system*. It is used exclusively in the navy, and largely in the mercantile marine, but in land practice both the forced-draught and the suction (*induced draught*) systems are used. They are even com-

bined in the same plant, the combination being called the *balanced-draught system*. In the forced-draught system, as used in the navy, the pressure in the stokehold may be anything up to 5 or 6 inches of water above the atmospheric pressure. The stokehold is a sealed chamber, and air is blown into it by large fans. Entry to the stokehold is obtained through an air-lock, i.e. a chamber having two doors. A man wishing to enter the stokehold opens the outer door and goes into the chamber. He then shuts this door and opens the door into the stokehold. In this way the great escape of air which would take place when anyone entered the stokehold is avoided.—BIBLIOGRAPHY: W. Inchley, *Steam Boilers and Accessories*; *Modern Mechanical Engineering* (Gresham Publishing Company).

Forcellini (for-chel-ē'nē), Egidio, an Italian lexicographer, born 1688, died 1768. The poverty of his parents deprived him of early advantages, and he was almost grown up when he began to study Latin in the seminary at Padua. Forcellini made rapid progress in Latin and Greek, and assisted his teacher Facciolati in his new and greatly augmented edition of *Calepin's Dictionary of Seven Languages*. The two friends then resolved to publish a complete *Latin Dictionary*. The execution of this great work, occupying nearly forty years of his life, devolved entirely upon Forcellini, though he had the counsel and supervision of his old teacher. It was published under the title *Ægidii Forcellini totius Latinitatis Lexicon, &c.* (Padua, 1771, 4 vols. folio).

Force Majeure, a term used to denote the occurrence of events which could not have been anticipated by human foresight or obviated by human agency.

For'ceps, a general name for a two-bladed instrument on the principle of pincers or tongs, used for seizing and holding, and for extracting objects which it would be impracticable thus to treat with the fingers. Such instruments are used by watchmakers and jewellers in delicate operations, by dentists in forcibly extracting teeth, for grasping and holding parts in dissection, for extracting anything from a wound, taking up an artery, and by accoucheurs.

Forcing, in botany, any interference with the normal life of a plant, which results in its flowering or fruiting at an unusual season. Heat is the agency most often employed; but lilac, for example, can be made to flower in winter by judicious treatment with ether vapour.

Ford, Henry, American automobile manufacturer, born in Michigan in 1863. As a boy he worked in an engineering shop, and subsequently became chief engineer at the Edison Illuminating Company. In 1903 he founded a business of his own, the Ford Motor Company,

which became the largest automobile factory in the world. During the European War Ford at first adopted the policy of bringing about peace as speedily as possible. For that purpose he brought over a party of Americans to Europe, but soon convinced himself of the fact that the Allied nations would not listen to the voice of peace as yet. When America entered the war, Ford abandoned his peace policy, and placed his resources at the disposal of his country, producing war material on a very large scale. In 1920 and 1921 he started an Anti-Semitic campaign in the United States.

Ford, John, English dramatist, was baptized at Islington, Devonshire, 17th April, 1586. Very little is known about his life, and it is quite uncertain when he died. He may have been at Exeter College, Oxford, for a while; he was admitted a member of the Middle Temple in 1602. As a young man he wrote some poetry of no outstanding merit; it is as a dramatist that he is famous. He is believed to have been of independent means, and so was less dependent on the stage for a livelihood than any contemporary playwright. *The Sun's Darling*, a masque in which Ford collaborated with Dekker, appeared in 1624. Ford's first independent play was *The Lover's Melancholy* (1628), a play strongly influenced by Burton's *Anatomy of Melancholy*. It contains the famous story of the nightingale's death, taken from Strada's *Prohusiones*. His next play, *The Broken Heart* (printed 1633), is one of the best and most celebrated of Ford's plays, and its plot is touching if somewhat melodramatic. *Love's Sacrifice* (also printed 1633) has an absurd plot, but much fine writing in it. *'Tis Pity she's a Whore* (printed 1633), like the lost *Æolus* of Euripides, turns upon the incestuous love of a brother and sister. In spite of its revolting subject, and in spite of the sensationalism that mars much of Ford's work, it is an arresting play, and it is most skilfully constructed. *Perkin Warbeck* (printed 1634) is a return to the chronicle history-play which had long been out of fashion. The background of reality has helped Ford to check the extravagances of his fancy, and the play is a good one. *The Fancies*, *Chaste and Noble*, and *The Lady's Trial* (1638) both mark a distinct decline. After the publication of the latter play Ford drops out of sight.

From the appearance of the First Folio of Shakespeare in 1623 drama became more literary. This partly explains why Ford's work differs from that of his predecessors. He was able to study the work of the older playwrights in book-form, and to look forward to having his own plays published eventually. Hence he took more pains than those earlier writers who merely prepared plays to be acted. He was a careful,

deliberate workman, who wrote mainly to please himself. Much of his work is marred by sensationalism. All commonplace plots had been already used up, and he seems to have felt that excitement must be kept up at all costs. Hence he deals with subjects untouched by Shakespeare, and introduces scenes like that in which Giovanni rushes to meet his father with the heart of his sister and paramour on a dagger. Ford had no sense of humour, and sinks below all the other Jacobean dramatists in the bad quality of his attempts at comic relief. He was, however, a beautiful writer of blank verse, he had great mastery over some of the technical difficulties of his art, and above all he had a deep knowledge of the passions and contradictory impulses of the human heart.—BIBLIOGRAPHY: A. C. Swinburne, *Essays and Studies*; Sir A. W. Ward, *History of English Dramatic Literature*.

Ford, Richard, English writer on Spanish subjects, was born in 1796, and died in 1858. He was educated at Winchester and at Trinity College, Oxford, where he took his B.A. degree in 1817. He then studied law and was called to the Bar, but never practised. From 1830 to 1834 he lived with his family in Spain, and in many riding-tours acquired an intimate knowledge of the country. Returning to England, he took up his residence near Exeter, and contributed several articles to the *Quarterly* and *Edinburgh Review* and other periodicals, dealing with Spanish art and architecture. In 1845 appeared the original edition of his excellent *Handbook for Travellers in Spain*, a veritable storehouse of information, rich alike in knowledge and in wit and humour. In subsequent editions this work underwent various changes, and was much reduced in bulk.

For'dun, John of, the father of Scottish history, born probably at Fordoun, Kincardineshire, soon after 1300, died about 1386. He wrote the first five books of his history known as the *Scotichronicon*, or *Chronica Gentis Scotorum* (in Latin), bringing it down to 1153, and part of the sixth, and left materials for its continuation down to his own period. It was resumed about 1441 by Walter Bower, abbot of the monastery of Inchcolm, by whom the five books of Fordun were enlarged, and eleven new ones added, bringing the history down to 1437. It exists in numerous MS. copies, and several printed editions have been published, the best of which is that of W. F. Skene, Edinburgh, 1871-2, with translation.—Cf. Sir Herbert E. Maxwell, *The Early Chronicles relating to Scotland: being the Rhind Lectures in Archaeology for 1912*.

Fore-and-aft, in ships, a term meaning in a line with the keel. *Fore-and-aft* sails are those that are set on a stay or guff and boom, such as jibs, stay-sails, &c.

Forecasting the Weather. This can be done fairly accurately by the meteorologist, his chief instruments being the barometer, thermometer, hygrometer (for measuring the amount of moisture in the air), and anemometer (which gives the direction and force of the wind). Absolute certainty of prediction, however, is not attainable, owing to our imperfect knowledge of the laws which govern the fluctuations of the weather. Generally speaking, a high or a rising barometer betokens fine weather, a low or falling one the reverse; but a rapid rise indicates unsettled weather. A piece of sea-weed forms a very practical hygrometer if kept from artificial warmth, becoming limp and sticky when rain is approaching. A red or rosy sky at sunset, whether cloudy or clear, and a grey sky in the morning indicate a fine day; and a red sky, especially redness in the clouds, in the morning is a sign of bad weather, rain or wind. One of the surest tokens of coming wet is an unusual clearness of the atmosphere near the horizon. The storm- or weather-glass is an instrument sometimes used to foretell weather changes. It consists of a mixture of camphor, nitrate of potassium, and muriate of ammonia, partly dissolved in alcohol, with a little water, the solution being placed in a large glass tube and hermetically sealed. The mixture assumes a more or less clear or cloudy appearance; when clear above and cloudy below, the indication is favourable; when in large part cloudy, it is unfavourable, signifying rain or storm. The reliability of this instrument is, however, disputed.

While some estimate of the probable weather changes may be made from careful observation of the sky and instrumental readings taken locally, a much more reliable forecast can be formed when information is obtainable from stations covering a wide area surrounding the district in question. In this country the Meteorological Office, which is now attached to the Air Ministry, receives daily by telegraph from a number of 'stations of the first order' reports of the weather elements at 7 a.m., 1 p.m., and 6 p.m. The data furnished are combined upon synoptic charts, which show at a glance the distribution of these factors—pressure, temperature, wind direction and force, cloudiness, rainfall, &c.—and their variations from place to place. In addition to stations within the United Kingdom, reports are received from places over the greater part of Europe, and also (by wireless telegraphy) from vessels traversing the Atlantic Ocean. The latter reports are of great utility, in view of the fact that so many storms reach our islands from the westward. Records of conditions in the upper atmosphere, obtained at certain places by means of pilot balloons, are also now a valuable item in the material avail-

able. The country is divided into 20 districts—8 in England, 2 in Wales, Isle of Man, 5 in Scotland, and 4 in Ireland—and for each of these the Meteorological Office issues daily forecasts of the probable weather for a period of twenty-four hours. General forecasts of the weather for the two or three following days are also issued daily.

In Britain, rainfall is due in the main to depressions travelling to us eastward over the Atlantic. The paths of most of these depressions lie to the northward of our islands. The winds in such a system circulate in a direction contrary to the hands of a clock, and near the surface they tend a little inwards towards the centre. From these facts it follows that before the trough of the depression reaches any locality the wind usually comes from the south-east. It shifts successively to s., s.w., w., and finally to n.w. in rear of the departing system. Our winds are predominantly south-west. When a shifting of the wind in a direction counter-clockwise, or against the sun, is observed, such as from s.w. to s.e., which is described as 'backing', the approach of a depression, and hence of rain, is generally indicated. Its approach is also commonly heralded by the appearance of cirrus clouds, which gradually thicken until the sky may become 'watery', being covered with a thin whitish veil, in which a halo around the sun may not infrequently be seen. See *Meteorology*.

Forecastle, a short deck in the forepart of a ship of war, or forward of the foremast, above the upper deck. In merchant ships it is the forepart of the vessel, where the sailors live.

Foreclosure, in English law, is the right of a mortgagee, or of anyone having interest in a mortgage, in the event of the conditions of the mortgage being violated, to compel the mortgager to redeem the pledge or forfeit his right of redemption.

Foreign Exchanges are the system under which the value of the money of one country in terms of that of others is determined. In London, the *rate of exchange* with any country usually expresses the number of units of the currency of that country which go to the pound sterling; sometimes, as in the case of the rupee, the quotation gives the number of shillings and pence to the foreign unit. Published lists, as a rule, give two rates, one at which a banker is prepared to buy, the other at which he will sell, or sometimes one representative 'best' paper, and the other good commercial bills. The chief influences affecting the foreign exchanges are (1) the relative demand for and supply of bills of exchange on the two countries concerned; (2) the comparative purchasing power of the currencies of the countries. When, for

example, French merchants have many payments to make in London, and only a limited number of bills in London are in the market, the number of francs given for a pound increases, and the rate moves in favour of London. The supply of and demand for bills of exchange is mainly determined by (a) the balance of imports and exports between the countries. Increased imports into one country means not only an increased supply of bills on that country, but increased demands for bills on the other to pay for the goods, and so move the exchange against the importing country. (b) Relative rates of discount, which determine whether it is worth while to transfer money from one country to another, thereby making it dearer or cheaper. (c) Political or other events which affect confidence, and so encourage or hinder investment in a country. The comparative purchasing power of currencies is to-day of supreme importance in determining rates of exchange. Owing to the currency of most countries now consisting of inconvertible paper, and to restrictions on the movement of gold, prices (which express the value of the currency limit in terms of commodities) in each country are largely independent of those in other countries, and with movements in comparative price level come movements in the exchange. Given the possibility of gold movement, the exchange may move so that it is cheaper to send gold one way or the other than to buy bills, and the exchanges are then said to have reached gold or specie point. —BIBLIOGRAPHY: Lord Goschen, *Foreign Exchanges*; G. Clare, *A.B.C. of Foreign Exchanges*; H. Deutsch, *Arbitrage*; Ottomar Haupt, *Arbitrages et Parités*; H. Withers, *Money Changing*; W. F. Spalding, *A Primer of Foreign Exchange*.

Foreign Legion, a unit of the French army, consisting of four regiments stationed at Sidi-bel-Abbis and Saïda in Algeria, and first raised in the time of Louis Philippe. In 1914 the strength of the four regiments was in the neighbourhood of 25,000 men, of which Germans, Alsations, Swiss, and Dutch provided some 50 per cent, French 15, Austrians 12, Italians 10, Spaniards 6, and other nationalities, including English, 7 per cent. It is thus evident that the Foreign Legion is, as its name implies, composed of representatives of every nation; the officers, however, are all French. Enlistment is voluntary, and is for a period of five years in the first place, which can be extended by further periods to complete the fifteen years' total service which qualifies for a pension. It should be noted that, contrary to the usual belief, the Foreign Legion is not a punishment corps, nor is it recruited necessarily from among fugitives from justice. (There are punishment corps in the French service, but they are known as battalions

of the African Light Infantry.) The Foreign Legion draws its recruits largely from among out-of-work artisans and craftsmen, thanks to which it is a very self-contained corps, and can with its own labour carry out many useful works. The Legionary can rise to the rank of under officer, and in rather exceptional cases to that of officer.

Foreign Office, the centre and head-quarters of the relations of Great Britain with all foreign powers, is, in its present organization and under its present name, a comparatively modern institution; but its first foundation may perhaps be traced to 1253, in which year, if not before, a Secretary to the Sovereign existed, the holder of that position being one John Maunsell. An assistant secretary seems to have been appointed 180 years later; while in 1539 the post of King's Principal Secretary was shared between two persons of equal standing, having charge respectively of the Northern and Southern 'Departments' or 'Provinces'. The Northern Department included the Low Countries, Germany, Denmark, Sweden, Poland, and Russia; English relations with France, Italy, Switzerland, Spain, Portugal, Turkey, &c., being the concern of the Southern official. The earliest use of the title 'Secretary of State' occurs in 1601, Sir Robert Cecil being styled by Queen Elizabeth "our Principal Secretary of State". The head-quarters of the two departments mentioned above were long the Cockpit, Whitehall, and Cleveland Row, St. James's, the two frequently exchanging offices. In 1782 the system of Northern and Southern Departments was abandoned, the first Secretary of State for Foreign Affairs as a whole being appointed in the person of Charles James Fox. Among the most distinguished of Fox's successors in office may be mentioned: George Canning (1812); Lord Palmerston (1830-4, 1835-41, and 1846); the Duke of Wellington (1834-5); Earl Granville (1846-52, 1868-74, 1880-5); Lord John Russell (1852, 1859-65); the Marquess of Salisbury (1874-80, 1885-6, 1886-92, and 1895); the Earl of Rosebery (1886 and 1892-4); and the present Foreign Secretary, the Marquess Curzon of Kedleston. In 1793 the head-quarters of the Foreign Office, which had been since 1786 at the Cockpit, Whitehall, were transferred to a block of houses leased in Downing Street; and finally, after a temporary removal to 7 and 8 Whitehall Gardens, to the present historic building in Downing Street, erected in 1868. The Secretary of State for Foreign Affairs receives a salary of £5000, and invariably occupies a seat in the Cabinet. He is assisted by a parliamentary under-secretary, a permanent under-secretary, and three assistant under-secretaries, legal adviser, and large staff of clerks. The presence at the Foreign Office of

responsible officials not liable to be displaced upon a change of ministry removes, or at least greatly minimizes, the danger of any sudden and violent change in the foreign policy of the country, which the advent to office of a new Foreign Secretary might otherwise produce. The duties of the Foreign Secretary and his staff range from such highly delicate matters as the negotiation of treaties and the selection and appointment of ambassadors, to a watchful care for the rights of every British subject, however obscure, residing in or visiting a foreign land, with a prompt attention to any well-founded complaints of such receiving improper treatment. The appointment of consuls and vice-consuls, with the issue of passports, is likewise in the hands of the Office.

Foreign Trade is the commercial exchange, between different states or self-contained communities, of goods and services. In the United Kingdom trade with all parts of the empire as well as with foreign countries is included in the returns of foreign trade. Exports are those goods which are sent out of the country, and imports those which are received, while re-exports are goods which have been imported, but are exported without any material change beyond repacking. In some degree foreign trade has always existed. The Phenicians were early pioneers, while Rome, which drew tribute of foodstuffs and luxuries from all parts of its empire, became the greatest trading city of ancient times. After the collapse of the Roman Empire conditions became too chaotic for settled commerce, but trade revived during the Middle Ages, although it was mainly confined to exchanges between adjacent countries such as England and the Low Countries. The Age of Discoveries opened up immense fields for enterprise, and started again great currents of foreign trade across the oceans, but generally such trade was of a speculative nature, as the common name of trading bodies, 'Merchant Adventurers', indicates. It was not until the industrial revolution revealed the possibilities of large-scale production that men realized that exchange between different countries might be greatly to the advantage of both, by giving each the opportunity to concentrate on that work for which they were best fitted. When the invention of steamships and railways followed the industrial revolution, and made possible the systematic opening up of new territories and the establishment of regular and speedy communication all over the globe, the great age of international trade began. In estimating how much trade has grown in the last century, and to what degree various countries have shared in this growth, certain difficulties arise. Comparison between different periods is rendered

difficult by changes in the level of prices, while comparisons between different countries are dangerous owing to differing methods of calculation. For instance the United Kingdom calculates its imports on the basis of c.i.f. values, while the values of imports into the United States are given f.o.b.; again, a number of states assess their foreign trade in terms of official values fixed by law or otherwise, which may differ considerably from the market value of the produce. Nevertheless, the growth of British foreign trade is sufficiently brought out by the following figures of trade to and from the United Kingdom:

BRITISH FOREIGN TRADE
(in millions)

	Imports		Exports		Re-exports
	£		£		£
1801 ..	31.8	..	24.9	..	10.3
1911 ..	522	..	278	..	65
1913 ..	768.7	..	525.3	..	109.6

Before the European War the United States and Germany were the only countries which had developed a foreign trade comparable in dimensions with that of the United Kingdom, and while both closely approaching this country in total value, calculating in proportion to population neither of these countries approached the British figures:

UNITED STATES IMPORTS AND EXPORTS
(in millions)

	Total Imports		Domestic Exports
	£		£
1901 ..	171.5	..	304.3
1911 ..	318.2	..	419.5
1913 ..	362.6		485.7

GERMAN EMPIRE IMPORTS AND EXPORTS,
SPECIAL TRADE
(in millions)

	Imports		Exports
	£		£
1901 ..	266.5	..	217.9
1911 ..	477.2	..	398.5
1913 ..	560.3	..	570

FOREIGN TRADE IN 1913
(per head of population)

	Imports		Exports		Total
	£		£		£
United Kingdom ..	17	..	12	..	29
United States ..	3.6	..	4.9	..	8.5
German Empire ..	9.4	..	8.1	..	17.5

The European War of 1914-8 cut across the lines of trade which had developed during the nineteenth century, and the reconstruction of international trade is perhaps the most serious and difficult problem of the post-war period. The figures of trade returns, owing to the great fall in the value of the money in which they are stated, should only be compared with pre-war returns after full allowance has been made for changes in value. British overseas trade in 1920 was as follows:

Imports ..	£1,936,742,120
Exports ..	£1,335,569,027
Re-exports ..	£222,405,957

The value of the trade was nearly two and a half times that of 1913, but the estimated volume was only 80 per cent of 1913.

A feature of foreign trade which has always commanded much attention is the relation between the quantities of imports and exports, the difference between these two being generally known as the Balance of Trade. For centuries it was held that a prosperous state should show a balance of exports over imports, and such a balance received and has retained the name 'a favourable trade balance'. This view was the result of the mercantilist fallacy that the object of foreign trade was the importation of precious metals to swell the treasure within the country. It is now realized that money in all its forms is only the denominator in international trade, and that unless a country is piling up debts or credits abroad its imports and exports must balance, when all the items are taken into account. The apparent difference in any case is due to the absence of certain items, generally called 'invisible imports or exports', from the returns of trade, in which account is only taken of material commodities. The invisible items fall under two headings, viz. services and payment of interest or capital. Among proceeds of services the most important are the earnings of shipping and of insurance and financial businesses, which are remitted to the country rendering them in bills, with the proceeds of which goods are bought, while in some instances the expenditure of foreign tourists is a large item. In the other case a country investing capital abroad sends goods abroad against a promise to pay interest or dividends as these may accrue; the goods exported appear in the return, while the consideration for which they are sent is an 'invisible import'. Later, when a country has invested large amounts of capital abroad, it receives interest on these sums in the form of goods. The United Kingdom has long had a large balance of imports over total exports, and the following is a rough

estimate of the way in which the balance is accounted for:

	1913 (in millions)	1920 (in millions)
	£	£
Surplus of imports over exports	133·8	378·7
Invisible exports:		
(a) Earnings of shipping ..	110	416
(b) Earnings of insurance and finance	25	40
(c) Interest on foreign investments	150	120

It will be seen that the 'invisible exports' were in reality greater than the adverse balance of trade, leaving a true balance of exports over imports which is accounted for by investments of British capital abroad, or by repayments of debt owed by Great Britain abroad, during the year in question.

Foreland, a cape or promontory projecting into the sea, as the North and South Forelands, two headlands in England on the coast of Kent, and between which are the Downs and Goodwin Sands. The former, on the north-east coast, 2½ miles S.E. of Margate, has a lighthouse 185 feet high, showing an intermittent light; it is also a wireless station. The latter, on the south-east coast, 3 miles N.E. of Dover, has two light-houses with fixed lights, 372 and 275 feet above high water.

Forensic Medicine, the branch of medical education which applies the principles and practice of the different branches of medicine to the elucidation of doubtful questions in a court of justice; otherwise called medical jurisprudence.

Foreshortening, in drawing and painting, is the application of the rules of perspective in representing objects so as to convey to the mind an impression of the full length of any object which is pointing more or less directly towards the spectator standing in front of the picture. The object is represented as shorter the more nearly it is perpendicular to the plane of the picture, and, at the same time, its proportions are so altered that the more distant parts become smaller relatively to the nearer parts.

Forest, a term properly applied to an extensive wood, or to a large tract of mingled woodland and open and uncultivated land; but also given to a large tract of hilly or mountain land wholly or chiefly devoted to the purposes of the chase. See *Deer-forest*.

Forest-fly, the popular name of a family (Hippoboscidae) of two-winged flies, parasitic on birds and quadrupeds. In the narrower sense the name is applied to a species (*Hippobosca equina*) which infests horses and cattle. Some

members of the family are wingless, as the ked or sheep 'tick' (*Melophagus ovinus*) and the bee-louse (*Braula cæca*), parasitic on the hive-bee.

Forest Hill, a suburb of London (south-east), 1 mile north of Sydenham. The Horniman Museum, opened to the public in 1901, is here. Pop. 20,800.

Forest Laws. In English law, a forest signified a certain territory, whether wooded or not, privileged for game, generally belonging to the sovereign and set apart for his recreation, under special laws, and having officers of its own to look after it. It was defined as containing eight things: soil, covert, laws, courts, judges, officers, game, bounds. It comprised both 'vert'—trees, underwood, and turf; and 'venison'—the hart, the hind, the hare, the boar, the wolf, which were beasts of forest; the buck, doe, fox, marten, which were beasts of chase; the rabbit, pheasant, partridge, quail, mallard, heron, &c., which were beasts and fowls of warren. The forest laws at one time were very oppressive. There are still several royal forests not disafforested, as Windsor Forest, the New Forest, the Forest of Dean, and Epping Forest.

Forest Marble, in geology, an argillaceous laminated shelly limestone, alternating with clays and calcareous sandstones, and forming one of the upper portions of the English Middle Jurassic series; named from Whychwood Forest, in Oxfordshire. The finer bands have been quarried as marble.

Forest-oak, the commercial term for the timber of trees of the genus *Casuarina*, belonging to Australia. Called also She-oak, Swamp-oak, and Beef-wood.

Forestry, the science of the right use and preservation of wooded areas; or the science and art of establishing and maintaining forests, and of managing them to the best advantage. The great forest tracts which have yielded and still yield the world's supplies of timber have been entirely the outcome of natural agencies, but in the future human agencies will no doubt be more and more brought into play in forestry along with these, as the natural forests become used up. Arboriculture, as distinct from forestry, is the cultivation of trees for ornamental purposes or scientific objects. Forests are of the utmost importance to a country, not only from the direct value of their timber and other produce, but also from the equilibrium in temperature and humidity which they tend to produce where they exist, regulating, as they do, the steady flow of water in springs and rivers, and correspondingly reducing the violence of floods, and preventing denudation of the earth and silting up of streams. Germany was the first country to reduce forestry (as distinguished from

mere arboriculture) to a science, the subject being taught, both theoretically and practically, in several forest academies, and the curriculum including botany, mineralogy, zoology, surveying, mensuration, embanking, draining, &c. The German forests are all mapped out in blocks, for the management of which elaborate working plans are drawn up. Grazing is allowed wherever practicable, also the use of the forests for recreation. France, Norway, Sweden, Denmark, and Italy are not far behind Germany in this important respect, but Great Britain is very backward, owing partly to the fact that so little of the small area at present devoted to forest (4 per cent of the whole area of the country) is in Government hands. Forestry, however, has been taught for years in connection with the Indian Forest Service first at Cooper's Hill College, and from 1903 at Oxford, and elementary instruction in the subject has been given at Cambridge, Edinburgh, Glasgow, Aberdeen, Dublin, Newcastle, Bangor, Wye, and the Royal Agricultural College at Cirencester (until its closure in 1915). Forest schools for working foresters have been established in the Forest of Dean, Rathdrum, and Penicuik. In British India, a system of Government forest administration has been developed with astonishing success, and has had an important bearing upon the pressure of famines, besides yielding a constantly increasing surplus over expenses (in 1919-20 £2,192,000). The only considerable timber-exporting countries in the world are Russia, Sweden, Norway, and Canada, and the first and last have still forests of enormous value. America is, of all regions of the world, the most largely covered with wood; yet in Canada more vigorous Government action is urgently needed, the wastage having been so enormous that some kinds of trees, notably the Weymouth pine, are almost extinct. In the United States the forest wealth has been vastly decreased, yet the States have still 63 million acres of forest, and more than twenty forest associations show and maintain the public interest in forestry. In Britain, since the European War, a Government Forestry Authority has been created, and afforestation has been commenced in several areas.

In the practice of scientific forestry there are two main objects kept in view. (1) To provide timber and various by-products. Different qualities are requisite in the kinds of wood used for different purposes, as, for instance, in the building of houses, ships, bridges, vehicles, &c., in house decoration, in the manufacture of furniture, musical instruments, sporting implements, pencils, &c. Hence great attention must be paid to the quality and value of the wood produced. By-products, too, are often of great importance, sometimes of more importance than

the timber itself; among these may be mentioned tar, turpentine, resin, tanning materials, &c. (2) To furnish such a condition of cover as will most favourably affect the climate of the neighbourhood. Situation, density, extent, and height are important considerations in this respect. Where an existing forest is being brought under organization, the problems presented are far simpler than where a new forest area is being formed. Broadly, they may be grouped under surveying, valuation, and administration. In constructing a new forest, after the site has been selected, it becomes necessary to consider the question of profit on capital expenditure, and this will depend largely on the judicious selection of trees suitable to the soil and climate, on easy communication with important markets, and on the attention paid to by-products. The grouping of trees, the division of the forest into districts, the methods of felling, the amount felled yearly, questions of pruning and thinning, &c., need the most careful attention. In forming a new forest it is generally advisable to plant densely (about 6000 or even more per acre). Mixed growths are generally preferable to the cultivation of one kind of tree only. Very often the planting of seedlings, from two to three years old, will be found more profitable in the long run than the sowing of seeds, though the latter is cheaper at the beginning. Several ingenious tools and machines for planting seedlings at a rapid rate have been invented, and have been used with great success. Special precautions are needed in forests against fire, and numerous pests of insect and fungoid character have to be combated. In connection with the transport of the timber the construction of a good road system is important. Generally speaking, although a number of years must necessarily elapse before a plantation begins to yield a pecuniary profit, yet timber-growing is very often found to be in the end a highly remunerative form of cultivation; while the benefit derived by the lands in the neighbourhood of plantations is also worthy of consideration.—BIBLIOGRAPHY: Forbes, *The Development of British Forestry*; J. Nisbet, *The Elements of British Forestry*; Sir W. Schlich, *Manual of Forestry*; F. F. Moon and N. C. Brown, *Elements of Forestry*; W. H. Whelens, *Forestry Work*.

For'far, or Angus, a maritime county on the east coast of Scotland, bounded north by counties Aberdeen and Kincardine, west by Perth, south by the Firth of Tay, and east by the North Sea; area, 559,037 acres. The surface is covered in the west and north-west by a portion of the Grampians, and in the south by part of the Sidlaw Hills. Between the Grampians and the Sidlaw Hills lies part of the valley of Strathmore, and between the Sidlaw Hills and

the Tay is the level but rich and highly cultivated tract of which the Carse of Gowrie forms a part. The chief rivers are the North Esk and the South Esk. All the operations of agriculture are carried on in the most approved manner, and nearly half the area is under crops. Cattle-rearing is carried to great perfection, the chief breeds being Shorthorns and polled Angus. The manufacture of linens or jute goods is carried on in all the towns (Dundee, Arbroath, Forfar, Brechin, Montrose, &c.), but has its central locality at Dundee. Sandstone flags are quarried in the Arbroath district. The county returns one member to Parliament. Pop. 270,950.

Forfar, the county town of Forfarshire, is a royal and parliamentary burgh, 13 miles north by east of Dundee. The public buildings include, besides churches and schools, a town house, county buildings, and public hall. The staple manufacture is linen, especially of the coarser varieties, there being several large factories, in connection with which are bleach-works. Forfar is one of the five Montrose burghs which return one member to Parliament. Pop. 9585.

Forfeiture, a punishment annexed to some illegal act or remissness of an owner or tenant of property, whereby he loses his interest therein, together with his title; the loss of goods entailed by some breach of law with which they are associated.

Forgery (Fr. *forger*, to fabricate), at common law, the fraudulent making or alteration of a writing to the prejudice of another man's rights, or the making, *malo animo*, of any written instrument for the purpose of fraud and deceit; the word *making*, in this last definition, being considered as including every alteration of or addition to a true instrument; also, the counterfeiting of a seal. The punishment of forgery at common law is, as for a misdemeanour, by fine, imprisonment, and such other corporeal punishment as the court in its discretion shall award. The punishments ordained for the offence by the statute law in England were once, with scarcely an exception, capital. Capital punishment for forgery was abolished by Acts of 1832 and 1861. The punishment now varies from penal servitude for life, or not more than fourteen or seven years, to imprisonment for not more than two years. The law on the subject has been consolidated by the Forgery Act, 1913.

Forget-me-not, the name of *Myosotis palustris*, nat. ord. Boraginaceæ, a common British plant growing generally in damp or wet places. Scorpion-grass is also a name for it and others of its genus. It is a very beautiful plant, and considered to be the emblem of friendship in almost every part of Europe. Its flowers are bright blue with a yellow eye. Forget-me-nots also grow in the United States. The dark-blue

forget-me-not of the Azores (*M. azorica*) is now cultivated in greenhouses, and has flowers of a beautiful brilliance.

Forging comprises the operations used in changing the shape of metal, generally iron and steel, by striking it with sharp blows by means of a hammer or some other suitable instrument, and the object thus produced is also known as a forging. If produced by a hammer worked by hand or by a steam-hammer, the process is known as hammer-forging, but where numerous objects are to be made of the same size and shape, drop-forging methods are used, which consist in forging a suitable piece of metal between prepared dies under a hammer, the lower part of the die being fitted to the anvil, and the upper part to the hammer itself and moving up and down with it. With simple shapes, one set of dies may be sufficient, but with complex shapes, two or more sets of dies may have to be used successively to produce the finished article. Hollow forgings are made by boring out the central portion and forging out on a mandrel. The term 'hydraulic forging' is often applied to a similar operation carried out by means of a hydraulic press, but as the action in this case is more of a steady squeeze, the term 'pressing' would be a more suitable expression. The various processes included in the operations of forging are swaging, which consists in the reduction or drawing down from a larger to a smaller section; upsetting, which is an enlargement of a smaller to a larger section; bending to any angle or curvature; welding, or uniting of pieces of metal to one another whilst in a plastic condition; punching, or the formation of holes and cutting off to suitable sizes.

Forlì, a town of North Italy, capital of a province of the same name, 38 miles south-east of Bologna. It is handsome and well built, has manufactures of silk ribbons, silk twist, and woollen stuffs, and a considerable trade. Forlì has a cathedral and is a bishop's sec. Pop. 48,943.

Forlì, the province of, is bounded on the east by the Adriatic; area, 730 sq. miles; pop. (1915), 816,420.

Forlorn Hope, a military term for a body of men, usually volunteers, selected from different regiments, to lead an assault, enter a breach, or perform other service attended with uncommon peril. The term is of Dutch origin; *hope* being from Dutch *hoop*, a company. The French equivalent is *enfants perdus*.

Formalin, a commercial product containing about 40 per cent of formaldehyde (CH₂O) in solution in water. It is prepared by passing the vapour of methyl alcohol, mixed with air, over glowing platinum or copper. Formalin is a pungent-smelling liquid which acts as a reducing

agent, separating gold and silver from solutions of their salts. It is used industrially as an antiseptic and disinfectant, in the coal-tar industry, in tanning, in waterproofing of fabrics, and for pharmaceutical purposes.

Forma Pauperis, *fn*, 'in the form or character of a poor person (pauper)'. By the laws both of England and Scotland provision is made for suits being carried on by individuals who are too poor to pay the usual fees. A suit conducted under these provisions is said to be a suit *in forma pauperis*. In England it is provided that anyone having a good cause of action, and taking oath that he is not worth £25 (formerly £5) beyond his wearing apparel and the subject in dispute, is entitled to have writs without paying fees, and the judges may assign him counsel and attorney, who shall act gratuitously. In Scotland similar provision is made for the poor, advocates and solicitors being annually appointed for the conduct of poors' cases before the supreme and sheriff courts.

Formation, in geology, any series of rocks referred to a common origin or period, whether they consist of the same or different materials. A geological system, or one of its subdivisions, may thus be spoken of as a formation.

Formente'ra, one of the Balearic Islands, about 12 miles long and 8 miles broad, hilly, woody, and but little cultivated. Pop. 2050.

Formi'ca, the genus to which some of the ants belong. A familiar form is the red wood-ant (*F. rufa*), the only British species that enslaves other ants.

Formic Acid (CH_2O_2), an acid originally extracted by water from crushed ants (*Lat. formica*, an ant), but now prepared from a mixture of glycerine and crystallized oxalic acid. It is contained in human sweat and the common nettle. It is a monobasic acid, and yields salts known as formates. It is a colourless volatile liquid, with pungent odour, and produces intense irritation on the skin.

Formo'sa, or **Tai-wan**, a Japanese island in the Chinese Sea, separated from China by a strait about 80 miles wide; length about 250 miles; average breadth, 70 miles; area, 13,839 sq. miles. A range of mountains (rising to 14,000 feet) divides it into a western and an eastern part, the former of which (mostly a plain) is occupied by numbers of immigrant Chinese and Japanese, and highly cultivated, producing in abundance rice, sugar, tea, pepper, camphor, oranges, and bananas. East of the mountains is a narrow strip steeply facing the sea. In the mountainous parts are wild tribes of Malayan race. Northern Formosa is liable to earthquakes. Railways have been and are being constructed, and several ports opened to European commerce, chiefly Tai-hoku (formerly Tai-peh, the capital),

Tai-nan, Tam-sui, Ke-lung, and Takow; and the trade since then has greatly increased. The chief exports are tea, camphor, sugar, rice; the imports are cottons, woollens, opium, &c. Formosa was ceded to Japan by China in 1895. Pop. (1918), 3,698,918.

Formosa, a West African island, one of the Bissagos (q.v.).

For'mula, a fixed form of words or symbols. In mathematics it is a general theorem, a rule or principle expressed in algebraic symbols. In chemistry it is a mode of expressing the composition of a compound by means of symbols and letters. Thus water is represented by H_2O , in which H_2 stands for 2 atoms or 2 parts by weight of hydrogen, and O for 1 atom or 16 parts by weight of oxygen.

Forres (for'es), a royal and municipal burgh of Scotland, county of Elgin, beautifully situated in a finely wooded country. Forres Castle was the residence of the early Scottish kings, and Shakespeare has made this neighbourhood the scene of the chief events in *Macbeth*. Forres is one of the Inverness district of parliamentary burghs. Pop. 4421.

Forrest, Edwin, an American actor, born in Philadelphia 1806, died in 1872. He showed an early talent for the stage, and in 1820 made his debut at Philadelphia as the hero in Home's play of *Douglas*. In 1826 he appeared before the New York public as Othello with signal success. In 1835 he visited England, making a third and last visit in 1844. He continued to act with great success at New York till 1871, when he retired. His chief characters were Othello, Macbeth, Hamlet, and Richard III.

Forrest, John, First Baron, Australian explorer and statesman, was born in Western Australia in 1847, died in 1918. He entered the Survey Department in 1865, and in 1869 commanded the expedition sent into the interior in search of Leichhardt. He was subsequently at the head of an exploring expedition along the coast from Perth to Adelaide, and of another which penetrated, with the aid of horses only, 2000 miles from Champion Bay through the middle of Australia, a service for which he received the gold medal of the Royal Geographical Society (1876). Appointed Deputy Surveyor-General of Western Australia in 1876, he conducted several trigonometrical surveys, and in 1883 was appointed Commissioner of Crown Lands and Surveyor-General, with a seat in the Executive and Legislative Councils. Forrest was the first Premier and Treasurer of Western Australia under responsible government (1890-1901), and introduced the system of free land grants of 160 acres, resigning office to become Minister of Defence in the first Federal Cabinet (1901-3). He was subsequently Minister for Home Affairs

(1903-4), and several times Commonwealth Treasurer. He was made a G.C.M.G. in 1901, and was raised to the peerage in 1918, shortly before his death. His works include: *Explorations in Australia* (1876), and *Notes on Western Australia* (1884-7).

Forst, a town of Prussia, in Lower Lusatia, on the Neisse, founded in the thirteenth century, 15 miles east by south of Cottbus, with important cloth manufactures and tanneries. Pop. 33,875.

Forster, Johann Georg Adam, German traveller, son of Johann Reinhold Forster, was born in 1754, died at Paris in 1794. He accompanied his father to Russia and England, and both accompanied Cook in his voyage round the world (1772-5). Subsequently he taught natural history at Cassel, held a professorial chair at Wilna, and became librarian to the Elector of Mainz. An excellent account of Cook's second voyage round the world was written by him in connection with his father. He also wrote: *Essays on Geography, Natural History, and Views of the Lower Rhine*.

Forster, Johann Reinhold, German writer, father of the foregoing, born in 1729, died in 1798. He studied theology at Halle, and became preacher at Nassenhuben. He chiefly devoted himself, however, to his favourite studies—mathematics, history, and geography. After having been engaged on a mission by the Russian Government, he migrated to London in 1766, and supported himself and his son Johann Georg partly by teaching. He was finally invited to accompany Captain Cook in his second voyage as naturalist of the expedition. An account of the voyage was published in his son's name (*Observations upon a Voyage around the World*, London, 1777). In 1780 he was invited to Halle as professor of natural history, and continued there until his death.

Forster, John, English writer, born at Newcastle 2nd April, 1812, died 1st Feb., 1876. While studying for the Bar in London he contributed to *The Examiner* and other periodicals. In 1843 he was called to the Bar, but his main interests were literary. He became editor of *The Daily News* in 1846 and shortly afterwards of *The Examiner*. In 1848 he published his *Life of Goldsmith*. In 1856 he retired from the editorship of *The Examiner*, having been appointed the year previous secretary to the Lunacy Commission, of which he became in 1861 a commissioner. During this period he devoted himself to historical studies, the result of which appeared in his *Arrest of the Five Members, Debates on the Grand Remonstrance, and Life of Sir John Eliot*. He also published biographies of Landor and Dickens, but died before completing his *Life of Swift*.

Forster, The Rt. Hon. William Edward, Eng-

lish statesman, born at Bradpole, Dorset, 11th July, 1818, died 6th April, 1886. He was the son of an eminent minister of the Society of Friends, and entered into the woollen trade at Bradford. In 1850 he married the eldest daughter of Dr. Arnold of Rugby. He was returned to Parliament for Bradford in 1861; became successively Under-Secretary for the Colonies (1865), vice-president of the Education Committee (1868), and a member of the Cabinet (1870). He had charge of the Education Bill of 1870 and the Ballot Bill of 1872. In 1880, the Liberals having just returned to power, Forster accepted the post of Chief Secretary for Ireland at a time when that country was distracted by agrarian and political tumults. The suppression of the Land League and the arrest of Parnell and the more violent agitators were carried out by Forster, but on the Government resolving to change its policy and release the Parnellites Forster resigned (1882). After this he was often found voting in opposition to the Government, particularly in matters of foreign and imperial policy.

Forsyth (for-sith'), William, English lawyer and writer, born 1812, died in 1900. After a brilliant career at Trinity College, Cambridge, he studied law, was called to the Bar in 1839, and became a queen's counsel in 1859. He represented the borough of Marylebone in the House of Commons from 1874 to 1880. Besides legal works, he wrote: *Hortensius, or the Duty and Office of an Advocate; History of Trial by Jury; Napoleon at St. Helena and Sir Hudson Lowe; Life of Cicero; Novels and Novelists of the 18th Century; and Hannibal in Italy*, a drama.

Forsythia, a genus of Chinese shrubs, ord. Oleaceæ, cultivated for their flowers, which appear early in spring, before the leaves.

Fort Augustus, a village of Scotland, county of Inverness, on the Caledonian Canal, about 33 miles s.w. of Inverness. It has its name from a fort erected in the vicinity in 1734 to overawe the Highlanders, who, however, succeeded in capturing it in 1745. It was occupied by a garrison till 1857, was purchased by Lord Lovat in 1876, and now forms the site of a Roman Catholic abbey and college. Pop. 791.

Fort de France, or **Fort-Royal**, a town and seaport, French West Indies, Island of Martinique, of which it is the capital. It has a fine harbour and strong fortifications. Pop. 26,399.

Forteviot, a village in Scotland, where was the ancient capital of the Pictish kingdom of Fortrenn. It is 7 miles south-west of Perth. Pop. 532.

Fort George, a fortress of Scotland, in the county of and 10 miles north-east of Inverness,

at the extremity of a low point of land projecting into the Moray Firth. It was built after the rebellion of 1745, and can accommodate about 2000 men.

Forth, a river of Central Scotland, formed in Perthshire by the junction of two streams, the Duchray and the Dhu, about 1 mile w. of Aberfoyle. From Aberfoyle the river flows south-east, forming for a considerable part of its course the boundary between the counties of Stirling and Perth, winding in its lower course in a series of curves known as the *Links of Forth*, and expanding thereafter into the *Firth of Forth*, which forms the most important harbour of refuge north of the Humber. Its chief ports are Leith, Granton, Bo'ness, and Grangemouth. The Forth is navigable for the smaller class of vessels as far up as Alloa. Its length is about 170 miles. It is a good salmon stream. There are several islands in the estuary, on two of which, the Isle of May and Inchkeith, lighthouses are erected. The firth is crossed at Queensferry by a bridge. See *Forth Bridge*.

Forth and Clyde Canal, a canal in Scotland, constructed between 1768 and 1790, and extending from the Forth at Grangemouth to the Clyde at Bowling, thus giving communication by water from the east to the west coast. It is 35 miles long. The Union Canal, 31½ miles long, joins it near Falkirk and connects it with Edinburgh.

Forth Bridge, the railway viaduct over the Firth of Forth at Queensferry. The firth here is about 4000 feet wide at low water. The small island of Inchgarvie is used as the central support of the two chief spans, which are 1710 feet wide each. These spans are each made up of two cantilevers extending towards each other from the opposite sides and connected by a girder, the cantilevers being 343 feet deep where they rest on the supporting piers and 40 feet at the free ends, and projecting 680 feet, while the central connecting girder is 350 feet in length. There are two other spans of 680 feet each, fifteen of 168 feet each, and seven small arches totalling about 400 feet. Including piers, there is about a mile of main spans and over half a mile of viaduct approach. The clear headway under the centre of the bridge is 150 feet above high water, while the highest part of the bridge is 361 feet above high water. Each of the main piers consists of a group of four cylindrical granite and concrete piers 49 feet in diameter at the top and from 60 to 70 feet at bottom. The deepest pier is about 70 feet below low water, and the rise of the tide is 18 feet at ordinary springs. In the piers there are about 120,000 cubic yards of masonry, and in the superstructure about 45,000 tons of steel. All the foundations are either on rock or on a

boulder-clay which for all practical purposes is as hard as rock; and the whole structure presents a network of bracing capable of resisting stresses in any direction and of any probable severity. The bridge carries two lines of rails. It was projected by a company in which the North British, Great Northern, North Eastern, and Midland Railways are interested. The engineers were Sir John Fowler and Sir B. Baker, C.E., and the contract price was £1,600,000. Operations were commenced in Jan., 1883, and the work was completed in the end of 1889.

Fortification, the science of strengthening a position by artificial means, and in such a manner that it can be defended by a force much inferior in strength to that by which it is attacked. Formerly a considerable difference existed between the methods used in permanent and field fortification; now the difference is less marked, and is more a matter of degree. At the present day the term *fortification* is usually applied to the construction of large works undertaken in peace-time as strategic defences of an area or city, while the expression *field engineering* (q.v.) embraces all defensive works undertaken in the field or in the immediate presence of the enemy.

Fort Madison, a town of the United States, Iowa, on the Mississippi, with railway works, meat-packing houses, &c. Pop. 8900.

Fortnightly Review, an English magazine so named from its having at first been published every two weeks, founded in 1865 under the editorship of G. H. Lewes. It has long appeared monthly. It was designed as a vehicle for philosophical Radicalism, but has since opened its columns to all schools of political thought.

Fortrose, a seaport, royal and municipal burgh of Scotland, Ross and Cromarty, on the inner Moray Firth, one of the Inverness and Ross and Cromarty burghs. Its two portions, Chanonry and Rosemarkie, were constituted a royal burgh in 1590. Pop. 963.

Fort St. George, the old citadel of Madras, and the earliest British settlement in India (1639), the name being sometimes used as equivalent to that of the city itself. It still contains the council chambers, barracks for European soldiers, and Government offices.

Fort Scott, a town in the east of Kansas, United States, an important railway centre. Pop. 10,463.

Fort Smith, a town of the United States, in Arkansas, on the southern bank of the Arkansas River. Pop. 23,975.

Fort Sumter, a fort on the entrance to Charleston Harbour, South Carolina, United States. At the opening of the War of Secession it was taken by the Confederates from the small body of United States troops by whom it was

garrisoned (13th April, 1861). It repulsed an attack of nine iron-clads on 7th April, 1863, and was heavily bombarded in August of the same year, but maintained its defence till the final evacuation of Charleston, 18th Feb., 1865. It has been rebuilt on a modified plan.

Fortu'na, the Roman goddess of success, corresponding to the Greek *Tychē*. She is generally delineated with a rudder, emblem of her guiding power; or, later, with a bandage over her eyes and a sceptre in her hand, and sitting or standing on a wheel or globe.

Fortuna'tus, the hero of an old popular legend. He obtained a wishing-cap and inexhaustible purse of gold, which finally ruined him and his sons. The first printed edition of the story appeared in Germany in 1509, but in various forms it has appeared in most of the languages of Europe. Thomas Dekker's play *The Pleasant Comedie of Old Fortunatus*, a dramatization of the story, appeared in 1600.

Fortunatus, a Latin poet, born in Northern Italy about A.D. 530; Bishop of Poitiers in 597; died about 609. His works were numerous, but he is remembered only by his hymns, one of which (*Vexilla regis prodeunt*) was adopted by the Church, and is well known in the modern version of J. M. Neale (*The royal banners forward go*).

Fortune, Robert, Scottish botanist and traveller, born in 1813, died in 1880. After an apprenticeship as a gardener, he entered the Edinburgh Botanical Gardens, and was subsequently employed by the Royal Horticultural Society as superintendent of their indoor-plant department at Chiswick. He visited China between 1843 and 1846 on the Society's behalf, and in 1848 for the East India Company. From China he sent home many fine plants, and in 1851 he introduced the Chinese tea-plant into the North-Western Provinces of India. He also visited Formosa and Japan, and collected tea-shrubs and other plants for the United States Government. His works include: *Three Years' Wanderings in the Northern Provinces of China* (1847), *Two Visits to the Tea Countries of China and the British Plantations in the Himalayas* (1853), *A Residence among the Chinese* (1857), *Yeddo and Peking* (1863).

Fortu'ny, Mariano, a Spanish painter, born near Barcelona 11th June, 1838, died at Rome 1874. He studied at Barcelona and Rome, travelled in Morocco, and settled at Rome, where he became the centre of a school of artists in revolt against over-study of the 'masters'. In 1868 he went to Paris, where his pictures, mostly genre subjects from southern and Oriental life, had a great success. Amongst the best known are: *A Spanish Marriage*, *A Fantasia at Morocco*, *The Academicians at Arcadia*, and *The*

Seashore at Portici. They are marked by great facility and brilliant colour, but are somewhat superficial.

Fort Wayne, a city of Indiana, United States, situated in a beautiful and well-cultivated country at the junction of the St. Mary's and St. Joseph's Rivers, which here unite to form the Maumee. It has railroad and machine works, and derives its name from a fort erected here in 1704 by General Wayne. It is the seat of a Roman Catholic episcopal see. Pop. 86,549.

Fort William, a town of Scotland, county of Inverness, at the foot of Ben Nevis, near the south end of the Caledonian Canal. It is named from a fort built here by General Monk, and rebuilt by General Mackay (1689), but now occupied as private dwelling-houses. Pop. 1913.

Fort William, a port and city of Canada, province of Ontario, on the Canadian Pacific Railway, near Port Arthur and the shore of Lake Superior. Pop. 16,500.

Fort Worth, a city in Texas, United States, on the south bank of the Trinity River. The numerous railways which enter the city from all sides give it a great importance; and there are numerous manufactures and industries, of which the woollen and flour are the chief. It is the seat of a university and of a technical college. Pop. 106,482.

Forum, among the Romans, any open place where the markets and courts of justice were held. There were a number of such places in Rome, by far the most celebrated being the great Roman forum (*Forum Romānum*) between Mount Palatine and the Capitoline Hill. This place, once adorned with the most beautiful statues and buildings, had become almost a waste known as the *Campo Vaccino*, or cattle-field, but since the end of last century the Government has made clearances and excavations and taken charge of the valuable relics which are still left.—In legal phrase *forum* signifies the court or place where an action is instituted.—**BIBLIOGRAPHY:** Middleton, *The Remains of Ancient Rome*; Platner, *The Topography and Monuments of Ancient Rome*; Smith, *Dictionary of Greek and Roman Antiquities*.

Fos'cari, Francesco, Doge of Venice, born about 1372, elected in 1423, and died 1st Nov., 1457. The whole period in which he governed the republic was one of war and tumult, campaigns being undertaken against the Turks, the Visconte of Milan, and others, in which Venice was mostly victorious, extending her dominion to the Adda. In his private life the doge was less fortunate. Three of his sons died in the service of the republic, and the fourth, Jacopo, being accused of receiving bribes from foreign princes, was condemned to torture and exiled to Crete, where he died. When eighty-five years

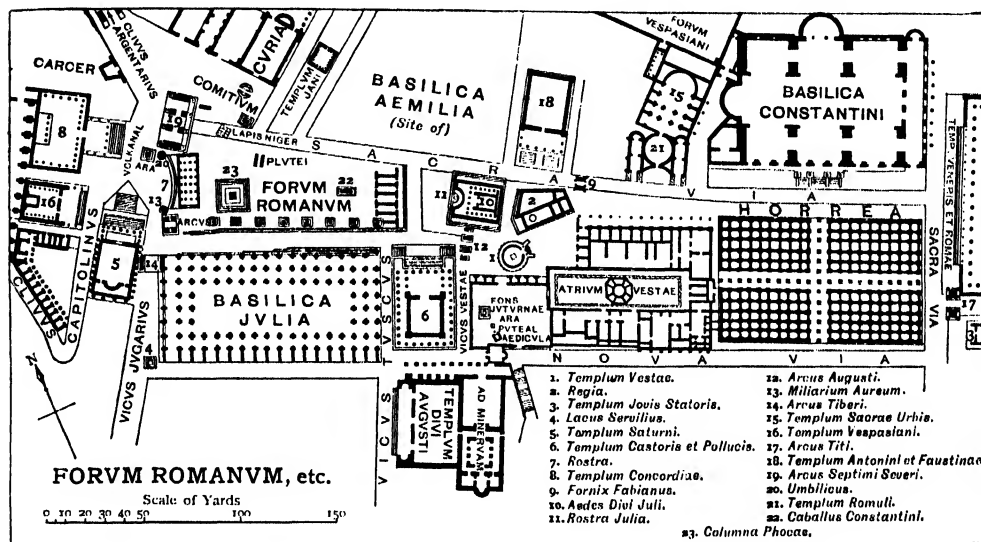
of age Foscari was deposed from the dogship at the instigation of a rival, Jacopo Loredano, and died a few days after. On the story of Jacopo Foscari is founded Byron's tragedy of *The Two Foscari*. Verdi has written an opera *I due Foscari*, and there is also a tragedy by Miss Mitford (1786-1855) *The Foscari*.

Foscolo, Ugo, an Italian poet and prose writer, born about 1776, died 10th Sept., 1827. He was educated at the University of Padua, and before the age of twenty he produced his tragedy *Il Tieste* (*Thyestes*), which was received with applause. His next work of importance was a

Fossa'no, a town in North Italy, on the Stura, 13 miles north-east of Cuneo. It is surrounded by old walls and defended by a castle. It is a bishop's see and has a cathedral. Pop. 18,175.

Fosse Way, or Fosse Road, one of the great Roman roads, from Cornwall by Bath, Coventry, and Leicester, to Lincoln. It is still traceable nearly all the way.

Fossils, in geology, any trace of an organism, animal or vegetable, found in rocks older than those forming at the present day. As time passes, and as modern deposits become antique, the bulk of fossil forms increases, and it is



Plan of the Roman Forum

romance somewhat in the style of Goethe's *Werther*, called *Ultime Lettere di Jacopo Ortis* (Last Letters of Jacopo Ortis). He then procured a commission in the army (First Italian Legion). After some military experiences under Massena at Genoa and elsewhere, in 1805 he retired and wrote *I Sepolcri*, one of the finest of his poems. He was subsequently appointed to a professorship at Pavia, of which Napoleon, displeased at his freedom of speech, soon deprived him. In 1812 he produced his tragedy of *Ajax*, and soon after that of *Ricciarda*. On the fall of Napoleon, Foscolo, who was obnoxious to the Austrians, retired to Switzerland; but finally, in 1815, went to London, where he met with a most favourable reception, and where he died. Besides the works already mentioned, his critical writings, *Essays on Petrarch* and *Discourses on the Texts of Dante and of Machiavelli's Il Principe*, are well known.

already permissible to speak of 'fossil man', when his bones are found entombed in the gravels of bygone rivers or the stalagmite of caves. The term fossil was originally applied to minerals also, in the broad sense of the Latin verb *fodere*, *fossus*, meaning 'to dig'. When William Smith (see *Geology*) wrote in 1816 he correctly referred to the remains described by him as "organized fossils", and these objects were often known as 'petrifications', since mineral changes had commonly made them denser and more stony than when they were first formed by organic processes. In museum catalogues of the close of the eighteenth century minerals were still included under fossils.

Fossils, in the modern sense, may be merely natural moulds of objects that have been dissolved away; they may even be casts of footprints, or the tracks of animals that crawled over the slime of drying shores. But in the

vast majority of cases they are shells, or bones, or the carbonized relics of vegetation, to which an organic origin must readily be assigned. The substance may have become denser; new mineral material may have replaced the old; but the external form remains, embedded in the preserving rock. The preservation of vegetable fossils has depended almost entirely on



Fossil Fern in Under-clay

their becoming entombed in water; the flora of the Coal-measures is thus best studied in the stems and branches washed out into some estuary from the forest-edge along the shore; and the coal-seams themselves, in which the specimens are massed together and in consequence obscured, owe their existence to the swampy conditions prevailing in the localities where they are found. For similar reasons, the marine fauna of all geological periods is far better known than that of the land. Lakes, like those of the Devonian period, may occasionally assist the record; but terrestrial remains are liable to be broken up and scattered long before they can be covered by a protective mantle of mud or sand.

Clays, owing to their impermeable nature, preserve fossils almost unchanged. The organic matter disappears; the wealth of colour passes from the shells; but even the most delicate foraminifera escape abrasion or solution. In sandstones or limestones the aragonite deposited to form the hard parts of corals and many shell-fish is soon replaced by the less dense mineral calcite, a change that must be accompanied by the removal of some of the original calcium carbonate; but unaltered aragonite shells have been traced in impermeable shales as far back as the Jurassic period. In some sandstones the change into the more stable form of calcite has not taken place before the shell has begun to crumble down and dissolve away, leaving only a mould

to show its former presence. The shell-substance of fossils may be replaced by chalcedonic silica (flint), iron carbonate (siderite), or even iron disulphide (pyrite or marcasite). In some cases the calcareous mud in filling the shell becomes thus altered, while the calcite shell remains. Phosphatized fossils, such as those of the Cambridge Greensand, are often mere internal moulds, the substance of which has been replaced by calcium orthophosphate (apatite); but the actual shell may at times be thus replaced. Fossil bones tend to lose their calcium carbonate and to increase their percentage of calcium phosphate and fluorine. The teeth of sharks are sufficiently abundant in some deposits to furnish an agricultural fertilizer.

The bones of land-animals are sometimes preserved, as at the farm of Pikermi in Attica, by having been swept into the flood-deposits of streams; but whole vertebrate skeletons, other than those of fishes, are rarely found. The story, often repeated, of Cuvier reconstructing an extinct mammal from a single bone is, of course, a somewhat thoughtless exaggeration; yet both Georges Cuvier and Richard Owen, with their wide knowledge of comparative anatomy, made wonderful predictions as to the nature of certain fossils from very scanty relics. These predictions from European specimens have in many cases been confirmed by the discovery of almost complete skeletons, or of mingled

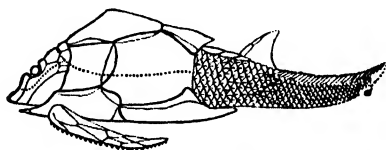


Fossil Lizard-tailed Bird in Lithographic Stone

material from which a typical skeleton can be assembled, in the dry deposits of the Central United States. The work of Cope, Marsh, and their successors has led to the erection in American museums of representations of the gigantic reptiles of the Mesozoic era, in which only a few ribs, digits, or vertebrae have been filled in by artificial modelling. Prior to these recon-

structions, almost the only large vertebrate skeletons that might be styled perfect were those of the marine reptiles, the enaliosaurs, which are so well represented in the Liassic shales of England.

At Solnhofen and Eichstätt, in Bavaria, a flaggy limestone of very delicate grain, the famous lithographic stone, has preserved a number of fossils that serve to show how imperfect the palæontological record is under more ordinary rock-conditions. The earliest known bird occurs in these strata, which are of Upper Jurassic Age, the impressions of its feathers being well exhibited. The forms of soft-bodied animals, such as jelly-fish, and the membrane of the wings of flying reptiles are similarly recorded in these limestones, and in Württemberg the whole form of *Ichthyosaurus*, showing unexpected fins, has been preserved as a mould around the skeleton. In many other strata,



Fossil Fish in the Old Red Sandstone of Scotland

creatures like worms are known by their tracks and borings, and regularly disposed impressions have been attributed to the movements of molluscs or crustaceans over the sea-floor; but it is obvious that many animals have been altogether incapable of appearing as fossils in the rocks. Curiously enough, those organisms that form their hard parts of opaline silica, the diatoms, the radiolarians, and a large group of sponges, have been far less frequently preserved than their calcareous associates.

Were it not that casual remains of crustacea and traces of worms occur in still older strata, the abundant invertebrate fauna of the Olenellus-beds of North-Eastern America would seem to indicate a special creation of life-forms at the opening of Cambrian times. The poverty of the evidence of earlier animals has been explained by the suggestion that they were incapable of utilizing salts of calcium for the construction of hard parts; or that salts of calcium were not available in the seas in a dissolved form; or that, as C. D. Walcott urges, the floors of the primeval oceans have not been uplifted to form parts of the continents now accessible to man. It seems unlikely that this last proposition will meet with general acceptance.

The presence of lacustrine fossils in arid regions may merely indicate an epoch of desiccation; the presence of marine fossils beyond

the reach of the existing seas indicates a shrinkage of the oceans or an elevation of the sea-floor into land. Often the elevation is clearly proved by the warping or even the contortion of the fossiliferous strata. The nature of the fossils, when compared with existing organisms, records in some measure the conditions of depth and climate under which the strata were laid down. All this seems obvious to thinking persons nowadays, and would have been accepted by the philosophers of antiquity as accordant with the facts observed. Aristotle, however, was inclined to believe that objects similar to the hard parts of organisms might be moulded by an inherent force in unconsolidated rocks; and his fame as a teacher, and the absence of mention in the Hebrew Scriptures of changes in the areas of land and sea prior to the Noachian deluge, made the idea of a plastic force welcome to philosophers in the darkness of the Middle Ages. The publication by Professor Beringer of *Lithographie Würzburgensis* in 1726, with figures of fossil shells bearing Hebrew inscriptions, and of other organic remains of a most fantastic nature, represents the latest flickering of notions that long retarded progress. As a matter of fact, the objects illustrated had been prepared by students of Würzburg University for the ultimate confusion of their own instructor.

William Smith in England from 1800 onwards, and Cuvier and Brongniart in the Paris basin in 1808, showed how strata of successive ages were characterized by the fossils that they contained; and henceforward fossils were utilized in assigning beds to their places in the long history of life upon the globe. A crowning interest was given to fossils when the doctrine of descent allowed zoologists and botanists to trace, from horizon to horizon, the chains of organisms that connect the extinct creatures of the earliest periods with the present faunas and floras of the globe. For Bibliography see *Geology*.

Fossombrone, a town of Central Italy, 38 miles w.n.w. of Ancona, on the Metauro, with a fine cathedral. Pop. 9700.

Foster, Sir George Eulas, Canadian statesman, born at Carlton, New Brunswick, 3rd Sept., 1847. He studied at the New Brunswick, Edinburgh, and Heidelberg Universities, and was appointed professor of classics and history at the University of New Brunswick in 1872, resigning his professorship in 1879. Elected to the Canadian Parliament in 1882, he was Minister of Marine and Fisheries in 1885, and Minister of Finance in 1888. In 1894 he visited England in connection with Dominion finances and negotiated an important loan. A convinced Imperialist, he joined Sir Robert Borden's Cabinet in 1911 as Minister of Commerce. He was made C.C.M.G. in 1918, represented Canada

at the Paris Peace Conference (1919), and was head of the Canadian delegation to the League of Nations at Geneva in 1920.

Foster, John, English essayist, was born in Yorkshire on 17th Sept., 1770, died 15th Oct., 1843. After a short trial of the weaving trade, he studied for the Baptist ministry, obtained a charge at Newcastle-on-Tyne, but, his preaching being unsuccessful, he took to literature, contributing extensively to the *Eclectic Review*. In 1805 he published four essays, very celebrated in their time, which established his fame as an author. Their titles are: *On a Man's writing a Memoir of Himself*, *On the Application of the Epitaph Romantic*, *On Decision of Character*, and *On Some of the Causes by which Evangelical Religion has been rendered less acceptable to Persons of Cultivated Taste*. In 1819 the celebrated *Essay on the Evils of Popular Ignorance* appeared.

Foster, Myles Birket, an English artist, born at North Shields in 1825, died in 1890. He learned wood-engraving under Landells, and in early life became a draughtsman. He soon achieved a high reputation as an illustrator of books and periodicals, and illustrated the works of Goldsmith, Scott, Longfellow, Beattie, &c. His landscape drawings on wood are of considerable merit. He afterwards devoted himself to water-colour painting of landscapes and rustic subjects, marked by over-elaboration, but delicate and sincere. In 1862 he was elected a full member of the Royal Society of Water-Colour Painters.

Fotheringhay, a village of England, 27 miles north-east of Northampton. In its castle Mary Queen of Scots was beheaded in 1587.

Foucault (fō-kō), Jean Bernard Léon, a French physicist, born 1819, died 1868. His name is especially connected with a celebrated pendulum experiment employed as a method of showing the rotation of the earth on its axis, by observing a vibrating pendulum. He also rendered services to optics, electric lighting, and photography.

Fouché (fō-shā), Joseph, Duke of Otranto, a minister of Napoleon I, was born in 1763, died 25th Dec., 1820. He was at first educated for the Church, but having adopted the principles of the Revolution, he became an advocate and was elected a member of the National Convention in 1792. Here he voted for the death of the king, and was implicated, at least nominally, in the atrocities of the period. On the fall of Robespierre (1794), Fouché, who had for some time tended towards the Moderate party, managed to make friends with Barras, and was rewarded for his betrayal by the ambassadorship to Milan. He was afterwards appointed Ambassador to Holland, but ultimately recalled to Paris and made Minister of Police. Here his peculiar talents had full scope; and although he

was twice dismissed by Napoleon, who did not altogether trust him, he always recovered his post, was loaded with riches, and made Duke of Otranto. He was Minister of Police at Napoleon's final abdication, and played an important part in the arrangements. He remained in office under Louis XVIII for a time, but the dislike of the Royalist party very soon forced him to resign (1815). He went as Ambassador to Dresden, but afterwards retired to Prague, and subsequently to Trieste, where he died.—Cf. L. Madelin, *Fouché*.

Fougasse (fō-gās') is a form of land-mine which may be used with considerable effect against troops attacking on a narrow front. It consists of an excavation in the form of an inverted cone, at the bottom of which is placed a charge of powder; over the charge is placed a heavy wooden shield, and over this again a load of stones or bricks of the appropriate weight for the charge. (It is calculated that 80 lb. of powder is sufficient to throw 5 tons of stones over a surface of 160 by 120 yards.) The axis of the inverted cone must be inclined to the front in accordance with the natural shape of the ground, so that when fired the contents shall cover the greatest area. A fougasse may be arranged to be fired either automatically by the approach of the enemy, or, after observation, by the defenders.

Fougères (fō-zhūr), a town of N.E. France, department of Ile-et-Vilaine, on a height 28 miles N.E. of Rennes. It was once fortified, so as to be considered one of the keys of Brittany, but is now open, well built, and has manufactures of flannels, sailcloth, and sacking. Pop. 21,150.

Fouillée, Alfred Jules Émile, French philosopher, born at La Pouëze, Maine-et-Loire, 18th Oct., 1838, died at Lyons 16th July, 1912. Educated at the lyceum of Laval, he was professor of philosophy at the lycées of Douai and Montpellier, and was subsequently appointed professor of philosophy at the University of Bordeaux. In 1872 he was called to the École Normale in Paris, but had to resign his post on account of ill-health and failing sight. At first a follower of Plato, Fouillée afterwards adopted the theory of empiricism, and endeavoured to connect Plato's idealism with the English doctrine of evolution. The synthesis of these doctrines he termed "the evolution of the ideal forces" (motor-ideas, or *idécs-forces*). In 1867 he published *Mémoires sur la philosophie de Platon*, and *Mémoires sur la philosophie de Socrate*, which were crowned by the French Academy. His other works include: *La Liberté et le déterminisme* (1873); *Histoire de la philosophie* (1875); *La Science sociale contemporaine* (1880); *Critiques des systèmes de morale contemporaine* (1883); *La Morale, l'art, et la religion*

d'après Guyau (1889); *La Psychologie des idées forces* (1893); *Psychologie du peuple français* (1898); *Nietzsche et l'immoralisme* (1902); *La Morale des idées forces* (1907); *Le Socialisme et la sociologie réformiste* (1909); *Esquisse d'une interprétation du monde* (1912).

Foula, an island belonging to the Shetland group, but lying solitary some 20 miles to the west. It rises from the sea in lofty cliffs which swarm with sea-fowl. Pop. 239.

Foulis (fou'lis), Robert and Andrew, two eminent printers of Glasgow, were born there—the former in 1707, the latter in 1712. Both were well educated at Glasgow University. In 1739 Robert commenced business as a bookseller, and, having obtained the appointment of printer to the University, began to issue editions of the ancient classics, which became famous for their accuracy and beauty. After some years Andrew entered into partnership with his brother, but outside speculations involved the firm in embarrassments. Andrew died in 1775, and Robert in 1776; the business was carried on by Robert's son, Andrew, who died in 1820.

Foundation, in engineering and architecture, is the formation upon which a building or structure is reared. In erecting a building, for instance, the surface earth is removed, and the building begins when the natural formation of the place is reached. The nature of this formation depends entirely on the locality of the structure. In one place it may be clay, which, when level, forms a very good foundation; in another, running sand, which forms an exceedingly bad one. It is essential that the foundation should not move, and, consequently, clay on a hillside, for instance, is to be avoided if possible, as clay so situated is apt to slip. Running sand is out of the question, unless specially treated. The permanence of the foundation being assured, its merit from one point of view is measured by the load it can carry per square foot. The following table gives the usual permissible loads (Colonel Seddon):—

Material.	Tons per sq. ft.
Hard rock	9
Rock, of strength of good concrete	3.
Very soft rock	1·8.
Firm earth and hard clay	1 to 1·5.
Clean dry gravel and clean sharp sand, prevented from spreading sideways	1 to 1·5.

In places where running sand, or an unreliable formation, is encountered, piling is often used. Wooden piles, which may be anything up to 100 feet long, are driven downwards into the ground, sometimes two or three being driven one above the other, so that the deepest one may go down some 300 feet. The piles may be wooden beams, or they may be made of concrete. They are driven into the ground by a pile-

driver. On the top of these piles a concrete raft is usually formed, which consists of a flat layer of concrete from, say, 3 inches to 5 feet thick. This concrete platform or raft is allowed to set, and upon it the building is erected. This type of foundation is obviously extremely costly, and is only resorted to when sites suitable for the particular structure in question are exceedingly difficult to get. For instance, large power-stations must be placed on the seaboard, or on the shore of a large river, so that there is direct access to very large quantities of water for cooling purposes. If this is not done a large capital expenditure on cooling-towers is incurred. The sites must also be favourably situated for coal-supplies. In such a case, if the main objection to a particular site is that the natural formation of the ground is not good, it may be the correct economic policy to put in an artificial foundation.

Submerged foundations are another important class which requires special treatment. This class includes the foundations of breakwaters, bridges, &c. It is usual to form such foundations with Portland cement, which is thrown, in sacks, into the sea or river where the foundation is required. In course of time these sacks of cement form a solid mass. Upon this artificial 'bed of rock' the structure is raised. In bridge-work every effort is made to find natural and firm foundations for the piers, but it may be necessary to reinforce these with concrete in the artificial way described above. Each of the columns of the Tower Bridge in London is raised on a bed of granite lying on the natural clay bed of the river.—**BIBLIOGRAPHY:** W. M. Patton, *A Practical Treatise on Foundations*; C. E. Fowler, *Ordinary Foundations, including the Cofferdam Process for Piers*.

Founding is the manufacture of metal castings by pouring the molten metal into suitably prepared moulds, and that part of works devoted to the production of castings is known as the foundry. The castings thus produced may generally be made at lower cost than wrought or forged objects of similar design, and in many cases of intricate design casting (q. v.) is the only method of production possible. The moulds used in the production of castings are commonly made of sand, and of these there are three classes, viz. green sand, dry sand, and loam. Green sand moulds are made of sand in the natural state (sufficiently wetted with water to make it adherent), which is packed by ramming around a pattern, usually of wood, having the shape of the casting required. After thus shaping the mould, the pattern is removed and the space thus formed is filled with molten metal. Dry-sand moulds, after being prepared, are thoroughly dried in suitable ovens before the metal is poured in. In loam moulding a sand rich in clay is used and

the mould is built up on a case of bricks and shaped by hand. This type of moulding is used for large objects. Machine moulding is largely used for small and medium-sized repetition castings, and is most economical when it is possible to mount and mould several patterns at the same time, and especially when the machine and pattern details are simplified to such an extent that skilled labour may be replaced by unskilled labour. Chill moulds contain metal portions inserted, in order to abstract the heat rapidly and thus cause local rapid solidification and cooling, which increases the hardness of the parts thus treated. For

ing children abandoned by their parents and found by strangers. Among such institutions are that of Paris (instituted in 1670), which grew out of a home established by St. Vincent de Paul in the reign of Louis XIII., and that of London, instituted in 1739. The latter, established by Thomas Coram (1668-1751), a sailor, was originally a hospital for all exposed children; but the enormous increase in abandonments caused the hospital to be changed in 1760 to one for poor illegitimate children whose mothers are known. There were over 700 inmates in 1921.—Cf. Sir John E. Gorst, *Children of the Nation*.



Fountain, Villa Borghese, Rome

metals other than iron, steel or iron moulds are commonly used, and are known as permanent moulds; these are also used for the production of pressure castings which are made with the metal under pressure. After the preparation of the moulds, the molten metal from crucibles, cupolas, &c., is poured or teemed into them. The metal may be poured directly into the top from some sort of ladle, but in the case of sand moulds the metal is generally run in at the side or bottom by means of a separate channel known as a runner. After the castings have been removed from the moulds, a certain amount of dressing is required for the removal of adherent sand, fins of metal, &c. In most cases the castings should be submitted to an annealing operation to remove stresses induced by unequal cooling and to reduce brittleness.

Foundling Hospitals, institutions for receiv-

Fount, or **Font**, among printers, a quantity of types, in proportions sorted for use, that includes ordinary letters, large and small capitals, single letters, double letters, points, commas, lines, and numerals; as a fount of Pica or Bourgeois. A fount of 100,000 characters, which is a common fount, would contain 5000 types of *a*, 3000 of *c*, 11,000 of *e*, 6000 of *i*, 3000 of *m*, and about 30 or 40 of *k*, *x*, *y*, and *z*. But this is only to be understood of the ordinary types, capitals having other proportions.

Fountain, a contrivance by which water is made to spout from an artificial channel, and often to rise up to a great height in a jet or jets. There are various kinds of artificial fountains, but in those of an ornamental character the water is usually made to rise in a jet by the pressure or weight of a head of water situated some distance above the orifice of issue, in which

case the water will rise nearly to the same height as the head. In some cities the public fountains form a feature on the streets. Rome, in particular, is noted for its fountains. At Paris, also, the fountains of the Place de la Concorde and of the Tuileries, and those at Versailles, are splendid structures.

Fouqué (fō-kā), Friedrich Heinrich Karl, Baron de la Motte, a German poet and novelist, born in 1777, died at Berlin in 1843. He was the grandson of General Fouqué, served as lieutenant of the Prussian Guards in the campaign of 1792, thereafter lived quietly in the country, but again returned to the army, and was present at the most important battles in the campaign of 1813. As a writer his work is marked by fantastic unreality and extravagance of conception. Several of his tales, *Der Zauberring* (Magic Ring), *Undine*, and *Aslauga's Ritter* (Aslauga's Knight), have been very popular. A translation of the last was made by Carlyle.

Fouqué, Heinrich August, Baron de la Motte, a distinguished Prussian general in the Seven Years' War, born in 1698, died in 1774. He was descended from an old Norman family which had fled on account of religious persecutions to the Hague. Fouqué's *Mémoires*, containing his correspondence with Frederick the Great, are highly interesting.

Fouquier-Tinville (fō-ki-ā-tan-vêl), Antoine Quentin, notorious for his ferocious cruelty in the first French revolution, was born in 1747. He was an attorney by profession, and, having attracted the attention of Robespierre, was appointed Public Accuser before the Revolutionary tribunal. His thirst for blood seems to have been increased by gratification, until it became a real insanity. He proposed the execution of Robespierre and all the members of the Revolutionary tribunal in 1794, but was himself arrested, and died under the guillotine, in a cowardly manner, in 1795.—Cf. Dunoyer, *Fouquier-Tinville, accusateur public du tribunal révolutionnaire*.

Fourchambault (fôr-shān-bō), a town of France, department of Nièvre, on the Loire. It has extensive iron-smelting furnaces and forges. Pop. 4882.

Fourcroy (fôr-krwā), Antoine François de, a French chemist, born in 1755, died in 1809. Having adopted the profession of medicine, he applied himself closely to the sciences connected with it, and especially to chemistry. In 1784 he was made professor of chemistry at the Jardin du Roi; and the next year he was chosen a member of the Academy of Sciences. At this period he became associated with Lavoisier, Guyton-Morveau, and Berthollet in researches which led to vast improvements and discoveries in chemistry. When the Revolution took place,

he was chosen a Deputy from Paris to the National Convention, but did not take his seat in that assembly till after the fall of Robespierre. In Sept., 1794, he became a member of the Committee of Public Safety. In Dec., 1799, Bonaparte gave him a place in the Council of State, in the section of the Interior, in which place he drew up a plan for a system of public instruction, which, with some alteration, was adopted. His works are numerous. We may mention his *Système des connaissances chimiques* and *Philosophie chimique*.

Fourier (fô-ri-ā), François Marie Charles, a French Socialist and founder of the system named after him, was born 7th April, 1772, at Besançon, died 10th Oct., 1837. He studied in the college of his native town, and subsequently at Rouen and Lyons occupied subordinate situations in mercantile houses. In the last-mentioned town he entered into business on his own account, but lost all his money owing to the outbreak of war, and was forced to enlist in the Revolutionary army. Discharged in 1795 on account of ill-health, he returned to commerce, filling quite subordinate situations, till he died. He wrote his books in his leisure hours, and published them out of his scanty savings. His first book, *Théorie des quatre mouvements et des destinées générales*, was published in 1808; the *Traité de l'Association Domestique Agricole*, his most important work, in 1822; but it was not till the last years of his life that they attracted any notice. In his social system Fourier holds that the operations of industry should be carried on by *Phalansteries*, or associations of 1800 members combining their labour on a district of about a square league in extent, under the control of governors elected by each community. In the distribution a certain minimum is first assigned for the subsistence of every member of the society, whether capable or not of labour. The remainder of the produce is shared in certain proportions to be previously determined among the three elements, labour, capital, and talent. The capital of the community may be owned in unequal shares by different members, who would in that case receive, as in any other joint-stock concern, proportional dividends. The claim of each person on the share of the produce apportioned to talent is estimated by the grade which the individual occupies in the several groups of labourers to which he or she belongs, these grades being in every case conferred by the voice of his or her companions. The remuneration received would not of necessity be expended in common. Separate rooms or sets of rooms would be set aside for those who applied for them, no other system of living together being contemplated than such as would effect a saving of labour in building and the processes of domestic

life, and reducing the enormous portion of the produce of industry at present carried off by middlemen and distributing traders to the narrowest possible margin. See *Communism; Socialism; Brook Farm*. — BIBLIOGRAPHY: Ch. Pellarin, *Ch. Fourier: sa vie et sa théorie*; E. Fournière, *Les Théories socialistes au XIX^{ème} siècle*; *Encyclopédie Socialiste*; Sambuc, *Le Socialisme de Fourier*; C. Gide, *Charles Fourier* (Petite Bibliothèque Économique).

Fourier, Jean Baptiste Joseph, a French mathematician, born at Auxerre 1768, died in 1830. He was educated in the military school of his native town, and after holding an appointment for a short time in the Polytechnic School, followed Bonaparte to Egypt. Here he performed important political service, and was likewise secretary of the Institute of Egypt. After his return he was, in 1802, appointed Prefect of the department of Isère. On Napoleon's return from Elba, Fourier issued a royalist proclamation, but was nevertheless appointed Prefect of the Rhone, though soon after deprived of the office. He now established his residence in Paris, devoting himself entirely to study, and was in 1815 admitted a member of the Academy of Sciences, and at a later period appointed secretary for life. In the opinion of Sir William Rowan Hamilton, Fourier was the greatest of the brilliant group of French mathematicians who flourished at the beginning of the nineteenth century, a group which included Laplace, Lagrange, Cauchy, and Poisson. Amongst his principal works are the *Théorie analytique de la chaleur* (1822), and *Analyse des équations déterminées*, published in 1831 after his death.

Fourier Series, infinite series involving cosines and sines of the successive multiples of a variable, i.e. series of the type

$$a_0 + a_1 \cos \theta + a_2 \cos 2\theta + a_3 \cos 3\theta + \dots \\ + b_1 \sin \theta + b_2 \sin 2\theta + b_3 \sin 3\theta + \dots$$

A function of θ represented by a convergent series of this type is *periodic*, the period being 2π ; for every term has the same value for $\theta + 2k\pi$ as for θ , where k is any integer. The corresponding form for a periodic function of period a instead of 2π can be written down from the above form by merely changing θ into $2\pi x/a$, the variable now being x . Any finite periodic function, subject to certain limitations of little practical moment, can be expressed by means of a Fourier series. This very important result is known as *Fourier's Theorem*. It was proved and applied to problems of heat conduction by Fourier in his beautiful work mentioned in the preceding article. The theorem has an application to functions which are not periodic. In fact, if we are given the values of

a function of x for all values of x between two end values, $x = 0$ and $x = a$ say, we may regard these data as defining one wave of a periodic function of x , the period of which is a ; in other words, we can define a periodic function so that one wave of it may have any assigned form. Hence any ordinary function whatever can be represented by a Fourier series for all values of x between two assigned end values. This remarkable property was a great stumbling-block to early investigators, who looked on such an equation as

$$\frac{1}{2}x = \sin x - \frac{1}{2} \sin 2x + \frac{1}{3} \sin 3x - \frac{1}{4} \sin 4x + \dots$$

as obviously erroneous, the right hand member being periodic, while the left is not. The result, however, is quite correct for values of x between $-\pi$ and π , exclusive of these end values.

A rigorous proof, or even statement, of Fourier's theorem in all its possible generality is not easy, the difficulty being chiefly due to the very great complexity of the modern conception of a function. On the other hand, if the theorem is assumed to be true, it is usually an easy matter to determine the coefficients in the expansion of a given function. Suppose, e.g., we require a series equivalent to the function x between $x = -\pi$ and $x = \pi$. We put

$$x = a_0 + a_1 \cos x + a_2 \cos 2x + \dots \\ + b_1 \sin x + b_2 \sin 2x + \dots$$

To find b_n , multiply both sides by $\sin nx$, and then integrate from $x = -\pi$ to $x = \pi$, assuming this to be allowable. We get

$$\int_0^\pi x \sin nx \, dx = b_n \int_0^\pi \sin^2 nx \, dx;$$

for all the other integrals on the right are easily proved to disappear. Thus $b_n = -2 \cos n\pi/n$; similarly $a_n = 0$, and the series is found in the form already written down above.

In almost every branch of applied mathematics, Fourier series are indispensable. As an example of their use, we may take the problem of a vibrating string, in the treatment of which by Daniel Bernoulli the series first made their appearance in analysis. It is known from the dynamics of the problem that a string held in the form $y = \sin nx$ (where y is the displacement of a particle at distance x from one end), and let go at the time $t = 0$, subject to the end points $x = 0$ and $x = \pi$ remaining fixed, will vibrate so that the displacement at time t is

$$y = \sin nx \cos nVt,$$

V being a constant depending on the tension

and density of the string. Now take the corresponding problem for a string with the same fixed ends, but with *any* initial form. We can expand the value of y for this initial form in the series $y = a_1 \sin x + a_2 \sin 2x + \dots$. The value of y at any time t is then

$$y = a_1 \sin x \cos Vt + a_2 \sin 2x \cos_2 Vt + \dots$$

The purely mathematical resolution of the original displacement into sinusoidal components $a_1 \sin x$, $a_2 \sin 2x$, &c., thus corresponds closely to that physical resolution of the vibration into harmonic components, which seems to be carried out by the ear in the process of hearing.—BIBLIOGRAPHY: H. S. Carslaw, *Fourier Series and Integrals*; W. E. Byerly, *Fourier's Series and Spherical Harmonics*; E. W. Hobson, *Functions of a Real Variable and Fourier's Series*; papers by G. A. Gibson, Proceedings of the Edinburgh Mathematical Society, vols. 11 and 12.

Fourmies (fôr-mê), a town of Northern France, department of Nord, an important centre of industry before the European War, during which it was occupied by the Germans. Pop. 14,140.

Fournet, d'Artigue du, French admiral, born in 1856. He saw service in the Tongking War of 1883, the Chinese War of 1885, and the Siam War of 1893, and commanded the French squadron during the Balkan War. Raised to the rank of vice-admiral, he commanded the Dardanelles fleet during the European War. Commander-in-chief of the French navy in 1915, he had the supreme command over the Allied fleets in the Mediterranean, and obtained, in Oct., 1916, the surrender of the Greek navy.

Fourth, in music, a distance comprising three diatonic intervals, or two tones and a half. Three full tones compose a tritone or fourth redundant. The diminished fourth consists of a whole tone and two semi-tones.

Fouveauux Strait (fô'vô), the strait between the South Island of New Zealand and Stewart's Island.

Fowey (fô'i), a seaport of England, in Cornwall, near the mouth of the River Fowey, formerly one of the chief seaports of England. In 1396 the town sent a number of ships to the siege of Calais. It carries on an extensive export of china clay. Pop. 2168.

Fowl, a word originally synonymous with *bird*, now used, except in compound words such as 'wild-fowl', in a stricter sense to designate the birds of the genus *Gallus*, of which the common domestic fowl (cock and hen) is a familiar example. The general form and characters of the bill, feet, &c., agree with those of the pheasants, but the crown of the head is generally

naked and furnished with a fleshy comb, the base of the lower mandible also bearing fleshy lobes or wattles—characters which are most conspicuous in the males. The legs of the male are furnished with spurs, which are much used in conflict, the cocks being very pugnacious and unable to suffer the presence of a rival. In the centre of the cock's tail are two long feathers, which fall backwards in a graceful arch and add great beauty to the whole aspect of the fowl. Except in the pure white breeds the plumage of the cock is always more splendid than that of the hen. There are four species, all native to South and South-East Asia. One of these, the *Red Jungle Fowl* (*Gallus bankiva* or *ferrugineus*), is most probably the original stock of the domesticated poultry. It ranges from North India to Cochin-China and the Malay regions, extending as far as the Philippines. Amongst well-known breeds are: *Game*, *Indian Game*, and *Dorking* (table varieties); *Andalusian*, *Leghorn*, and *Minorca* (laying varieties); *Orpington*, *Plymouth Rock*, *Rhode Island Red*, and *Wyandotte* (utility); *Bantam* and *Silky* (fancy).—Cf. article in *Standard Encyclopædia of Agriculture*.

Fowler, Sir John, civil engineer, was born near Sheffield in 1817, died in 1898. Originally a pupil of the engineer of the Sheffield waterworks, he was subsequently engaged on the London and Brighton Railway, and in 1842 returned to the north and became resident engineer of the Stockton and Hartlepool line. In 1844 he set up in London as consulting engineer, and was connected with various important undertakings. He was for many years engineering adviser to the Khedive of Egypt, and with Sir Benjamin Baker was chiefly responsible for the design of the Forth Bridge, opened in 1890. Greatly interested in railway improvements and dock-construction, he was president of the Council of the Institution of Civil Engineers in 1866, was created a K.C.M.G. in 1885, and a baronet in 1890.

Fowler, Rev. Thomas, D.D., English philosophical writer, was born in 1832, and died in 1904. He studied at Merton College, Oxford, and graduated with first-class honours in both classics and mathematics in 1854, soon after becoming fellow and tutor of Lincoln College. From 1873 to 1889 he was professor of logic in the university, and in 1881 was elected president of Corpus Christi College, retaining the post until his death. He was also vice-chancellor of the university from 1899 to 1901. His published works include two volumes on *Logic*, *Deductive Logic* (1867), and *Inductive Logic* (1870), reproductions, in the main, for Oxford use, of J. S. Mill's logical system; editions of Bacon's *Novum Organum*, with introduction and notes, and Locke's *Conduct of the Understanding*; *Pro-*

gressive Morality, an Essay in Ethics; Principles of Morals; and monographs on Locke, Bacon, Shaftesbury, and Hutcheson.

Fowling, the taking of wild birds in numbers, either for food or for their feathers. It includes a variety of methods, such as the catching of small birds by nets, the taking of ducks and other water-fowl in decoys, and the lowering of persons over the brink of precipices to seize the birds that lodge in their hollows and shelves.

Fox, an animal of the genus *Canis*, closely allied to the dog, with a straight bushy tail, elongated pupils, and erect ears. Foxes are natives of almost every quarter of the globe, and are everywhere among the most sagacious and wily of all beasts of prey, very voracious, devouring birds and small quadrupeds, and committing ravages not only on animals, but on fruits, honey, and eggs. The common fox of Europe (*Canis vulpes*) and Asia is well known. Among other species there are the Arctic fox (*C. lagopus*), celebrated for its glossy white winter fur; the silver or black fox (*C. argentatus*), similar to the common fox, but distinguishable by its rich, shining black fur, a native of the northern parts of Asia and America; the grey fox (*C. virginianus*) has a thick tail containing at its tip a tuft of stiff hairs, common through the northern parts of America; the red fox of America (*Vulpes fulvus*), generally of a pale-yellow hue; the cross fox (*C. pennsylvanicus* or *decussatus*), fur a sort of grey, muzzle and lower parts of body black, a dark cross on the shoulders; the kit fox (*C. velox*), an inhabitant of the plains which lie at the base of the Rocky Mountains. The little desert fox (*C. leucopus*) of South-West Asia, and its ally the corsac fox (*C. corsac*) from Central Asia, are also deserving of notice.

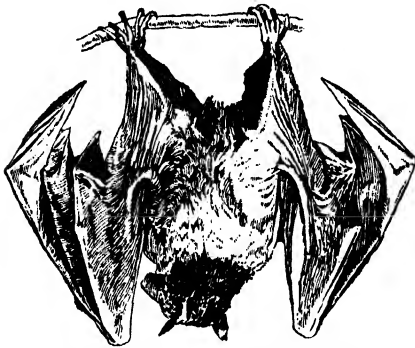
Fox, Charles James, an eminent English statesman, the second son of Henry, first Lord Holland, was born 24th Jan., 1749, died 1806. He was sent to Eton, whence he removed to Hertford College, Oxford. His father procured him a seat for the borough of Midhurst in 1768, before he was of legal age, and in 1770 he was appointed one of the Lords of the Admiralty, which situation he resigned in 1772, and was appointed a Commissioner of the Treasury. After being a supporter of the administration for six years, a quarrel with Lord North threw Fox into the ranks of the Whig opposition, where, along with Burke and others, he steadily assailed the Government, especially on the score of their American policy. In 1780 he was elected member for Westminster, and on the defeat of the administration of Lord North, and the accession of that of the Marquess of Rockingham, he obtained the office of Secretary of State for Foreign Affairs (1782). But the death of the Marquess of Rockingham suddenly divided the party; and when the Earl of Shelburne

became First Lord of the Treasury, Fox retired. Soon after a union took place between his friends and those of Lord North, known as the *coalition ministry*, which was overthrown by Fox's famous East India Bill (1783). At the ensuing election nearly seventy of his friends lost their seats; but though Pitt had a decided majority, Fox still headed a very strong opposition, and for some years political questions were contested on both sides of the House with a great display of talent. He took an active part against Warren Hastings, supported the efforts of Wilberforce against the slave trade, and moved the repeal of the Test and Corporation Acts. He welcomed the breaking out of the French Revolution, and his views on this subject led to a memorable break between him and his old friend Burke. Fox firmly opposed the principle on which the war against France was begun, and strenuously argued for peace on every occasion; but eventually, on becoming Secretary for Foreign Affairs in 1806, acquiesced in its propriety. His health, which had been impaired by his loose manner of living, now began rapidly to decline, and he died the same year, a few months after the death of Pitt, his great rival. As a powerful and purely argumentative orator he was of the very first class; although as to eloquence and brilliancy he perhaps yielded to Pitt, Burke, and Sheridan; nor were his voice and manner prepossessing, although highly forcible. He was of an amiable nature, and a sincere friend to all broad and liberal principles of government. His *History of the Early Part of the Reign of James II* was published posthumously.—**BIBLIOGRAPHY:** Lord John Russell, *The Life of C. J. Fox*; Sir G. O. Trevelyan, *Early History of C. J. Fox*; J. L. Le B. Hammond, *Charles James Fox: a Political Study*; W. E. H. Lecky, *History of England in the Eighteenth Century*.

Fox, George, the founder of the Society of Friends, or Quakers, was born at Drayton, in Leicestershire, in 1624, his father being a weaver, and died in 1691. He was educated religiously, and at the age of nineteen persuaded himself that he had received a divine command to forsake everything else and devote himself wholly to religion. He accordingly forsook his relations, equipped himself in a leathern doublet, and wandered from place to place, supporting himself as he could. During this itinerant life he fasted much, sometimes sitting the whole day in a retired spot reading the Bible. In 1648 he commenced to preach publicly at Manchester, about which time he also adopted the peculiar language and manners of Quakerism. At Derby his followers were first denominated *Quakers*, in consequence of their trembling mode of delivery, and calls on the magistracy to tremble before the Lord. In 1655 he was sent a prisoner to

Cromwell, who, having ascertained the pacific tendency of his doctrines, had him set at liberty. He was, however, treated with great severity by the country magistracy and the sterner Puritans, who disliked the mysticism and want of firm doctrines in his preaching. In 1666 he set about forming the people who had followed his doctrines into a formal and united society. In 1669 he married the widow of Judge Fell, and soon after went to America, where he remained two years, which he employed in making proselytes. On his return he was thrown into Worcester jail, where he remained for over a year. On his release he went to Holland. He soon after returned, and was cast in a suit for tithes, which he deemed it unlawful to pay. In 1684 he again visited the Continent. At the time of his death the Society of Friends (q.v.) had acquired considerable importance. The writings of Fox have been collected into three volumes.—Cf. Bickley, *George Fox and the Early Quakers*.

Fox-bats, or Flying-Foxes, a name given to the fruit-eating bats of the family Pteropodidæ,



Fox-bat or Flying-Fox (*Pteropus edulis*)

including some of the largest of the bat tribe, one species, the *Pteropus edulis* or kalong, attaining a length of from 4 to 5 feet from the tip of one wing to the tip of the other. They inhabit Australia, Java, Sumatra, and Borneo, as well as the continents of Asia and Africa.

Foxe, John, an English Church historian, born in 1517, died in 1587. He studied at Oxford, and was elected a fellow of Magdalen in 1543, from which he was expelled two years later on a charge of heresy. In the reign of Edward VI he was restored to his fellowship, but during Mary's reign again went abroad, to Basel. On the accession of Elizabeth he returned to his native country, and was received in the most friendly manner by his former pupil, the Duke of Norfolk, who settled a pension on him. Secretary Cecil also obtained for him a prebend

in the church of Salisbury; and he might have received much higher preferment if he would have subscribed to the articles enforced by the ecclesiastical commissioners. His principal work is the *History of the Acts and Monuments of the Church*, commonly called Foxe's *Book of Martyrs*, first printed in 1563, in one volume folio. An edition of this work, by Stoughton, appeared in 1877.

Fox'glove, a common British plant, *Digitālis purpurea*, nat. ord. Scrophulariaceæ. It grows

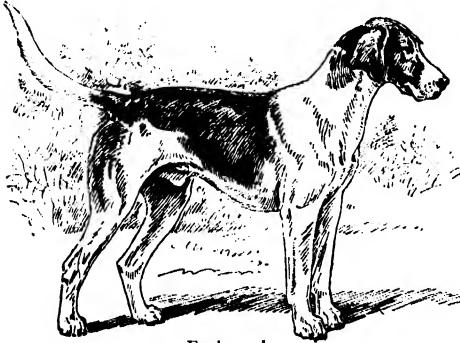


Foxglove (*Digitālis purpurea*)

on banks, pastures, &c., in hilly and especially subalpine and rocky countries in Europe. Its flowers are campanulate, and somewhat resembling the finger of a glove. It is one of the most stately and beautiful of the British herbaceous plants, and one that has great reputation as a medicinal plant, being employed as a sedative, narcotic, and diuretic in diseases of the heart and in dropsy. Its medicinal properties are due to the poisonous substance known as *digitalin* (q.v.). A decoction or infusion of the leaves is what is generally used. The flowers are usually purple, but sometimes white. Several species

are grown in gardens, such as *D. grandiflora* and *D. lutea*, with yellow flowers, and *D. ferruginea* with brown.

Foxhound, a hound for hunting foxes, a variety of hound in which are combined, in the highest



Foxhound

degree of excellence, fleetness, strength, spirit, fine scent, perseverance, and subordination. The foxhound is smaller than the staghound, its average height being from 20 to 22 inches. It is supposed to be a mixed breed between the staghound or the bloodhound and the greyhound. It is commonly of a white colour with patches of black and tan.

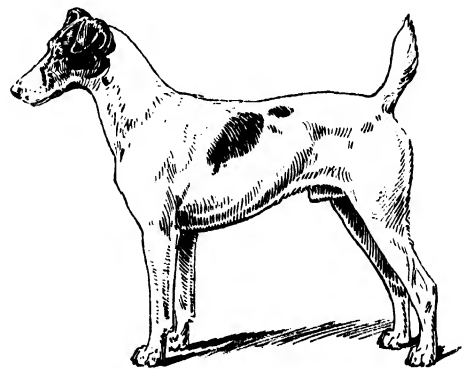
Fox-hunting, a favourite English sport much practised during the autumnal and winter months. A *pack* of foxhounds consists of from 20 to 60 couples of hounds, according to the frequency of the hunting days. These dogs are carefully bred and trained, and are under the superintendence of one experienced gentleman called the *master*, who has the general control of the whole 'field'. Under him is the *huntsman*, whose duty it is to look after the hounds in their kennels and direct them in the field. He is directly responsible for their condition and training. Next him are the *whippers-in*, whose main duty is that of assisting generally the huntsman both in the kennels and in the field. A less important function of the whipper-in is that of urging on lagging hounds. The night before the hunt, the gamekeeper, calculating on the habits of the fox to leave his burrow or 'earth' in search of food at night, stops all the 'earths' after the foxes have left them. The animals are thus forced to seek refuge in neighbouring thickets or other cover, generally near their 'earth', and this fact determines the arrangements of the day's hunting. The huntsmen assemble in the neighbourhood of the stopped 'earth' and draw the neighbouring coverts by *throwing off* the dogs to search for the fox. The presence of the fox is generally indicated by the whine of some old and experienced hound who has first

scented him; but he may *hang* or keep within the covert for a long time. The person who first sees the fox leave the covert, *break cover* as it is called, gives the *view-halloo* after it has got some little distance, upon which the huntsman collects his hounds and sets off in a chase followed by the entire field. The foxhounds follow almost entirely by scent, the fox being itself perhaps far ahead and out of sight. Wherever, therefore, the scent fails the hounds are *at fault*, and there is a *check* till the scent is recovered. When the scent is good, most of the hounds *own* it by giving tongue, and they are then said to be in *full cry*. The rider who is first in at the *death* lashes the hounds off and secures the head, feet or *pads*, and tail or *brush* of the fox. The midland counties of England, Leicester, Warwick, Yorkshire, &c., are the most celebrated for fox-hunting.

Fox Indians, a tribe of North American Indians belonging to the Algonquin family, now few in numbers and scattered over the Indian territories, Iowa, Kansas, and Nebraska.

Fox River, a river of Wisconsin, United States, which enters Green Bay, an arm of Lake Michigan, after passing through Lake Winnebago. It is connected by canal with the River Mississippi, and thus furnishes water communication between that river and the Atlantic.

Foxtail-grass, the common name given to the grasses of the genus *Alopecurus*, because of the close cylindrical panicle in which the spikelets of flowers are arranged, having somewhat the shape of a fox's tail. Of the fourteen species known, six are natives of Britain. *A. pratensis* is an abundant natural grass in meadows and pastures, and is an excellent fodder plant. The alpine foxtail-grass (*A. alpinus*) is a rare plant,



Fox-terrier

being much prized and eagerly sought after as a botanical rarity.

Fox-terrier, a favourite breed of dog, white, with black or tan markings (like a fox-hound),

coat rough or smooth, hard and dense, ears drooping, legs straight, weight not more than 17 lb.; strong, active, and courageous, intelligent, and useful against vermin, keen in driving foxes from their lurking-places.

Foy (fwá), Maximilian Sebastian, a French general, born in 1775, died at Paris 28th Nov., 1825. He was educated in the military school at La Fère, and served with distinction under Dumouriez, Moreau, and Masséna. In 1803 he received the command of the floating batteries intended for the defence of the coasts of the Channel, and in 1805 commanded the artillery of the second division in the Austrian campaign. In 1807 he took part in the preparations for the defence of Constantinople against the British. From 1808 to 1812 he was general of division of the army in Portugal. In 1812, after the defeat of the French at Salamanca, he succeeded Marmont as commander-in-chief, and showed much talent in his conduct of the operations on the Douro. He was present in all the battles of the Pyrenees, until he was dangerously wounded at Orthez in 1814. In 1815 he commanded a division at Waterloo, where he was wounded for the fifteenth time. In 1819 he was appointed division-inspector of infantry, and the same year was elected Deputy by the department of the Aisne. He at once distinguished himself as one of the leading orators of the Liberal party, and became very popular.

Foyers, Falls of, two striking cataracts near the mouth of the little River Foyers, Inverness-shire, which falls into Loch Ness. The upper fall is about 30 feet in height, the lower, 'the most magnificent in Great Britain', is about 165 feet. It now generates electricity for important aluminium works.

Foyle, a river of Ireland, which flows north-east through Tyrone, Donegal, and Londonderry till it falls into Lough Foyle 4 miles below the city of Londonderry. It is navigable up to Londonderry for vessels of 800 tons.

Foyle, Lough, the estuary of the River Foyle, on the north coast of Ireland, between the counties of Derry and Donegal. It is 16 miles long from north-east to south-west, 1 mile wide at its entrance, and 9 miles broad in the interior. A great part is dry at low water.

Fra Bartolommeo. See *Bartolommeo*.

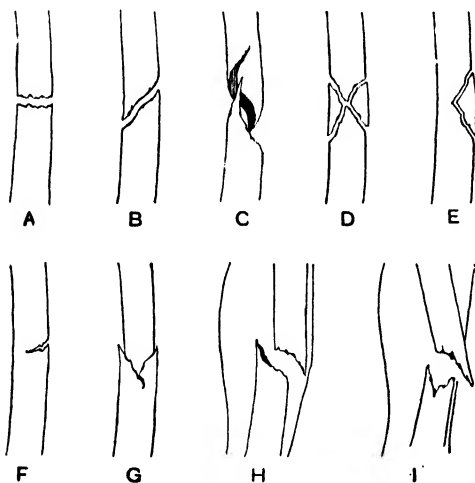
Fraction, in arithmetic and algebra, a combination of numbers representing one or more parts of a unit or integer: thus, four-fifths ($\frac{4}{5}$) is a fraction formed by dividing a unit into five equal parts, and taking one part four times. Fractions are of two kinds, *vulgar* and *decimal*. *Vulgar* fractions are expressed by two numbers, one above another, with a line between them. The lower, the *denominator*, indicates into how many equal parts the unit is divided; and the

number above the line, called the *numerator*, indicates how many of such parts are taken. The *solidus* notation is now frequently used, chiefly for the purpose of avoiding the troublesome process of 'justification' in printing. In this notation the result of dividing *a* by *b* is denoted by *a/b*. A *proper fraction* is one whose numerator is less than its denominator. An *improper fraction* is one whose numerator is not less than its denominator, as $\frac{8}{5}$. A *simple fraction* expresses one or more of the equal parts into which the unit is divided, without reference to any other fraction. A *compound fraction* expresses one or more of the equal parts into which another fraction or a mixed number is divided. Compound fractions have the word *of* interposed between the simple fractions of which they are composed: thus, $\frac{2}{3}$ of $\frac{4}{5}$ of $1\frac{1}{2}$ is a compound fraction. A *complex fraction* is one which has a fraction either in its numerator or denominator, or in each of them: thus, $\frac{5\frac{1}{2}}{9}$, $\frac{8}{9\frac{1}{2}}$, $\frac{5\frac{1}{2}}{6\frac{1}{2}}$, are complex fractions. See *Decimals*.

Fracture, in mineralogy, is the manner in which a mineral breaks so that its texture is displayed. The fracture is *even* when it shows a level face or plane of some extent; *uneven*, when the surface is rough and broken; *conchoidal*, when one side is convex and the other concave, as in a molluscous shell; *fibrous*, when the separated edges have the appearance of torn filaments; *hackly*, when there are many fine sharp points or inequalities. The same term is used in connection with metals and alloys, and the nature of the fracture of these is found to be intimately connected with the crystalline form, and often gives a useful indication of the purity or otherwise of the substance. The fracture of metals is usually described as crystalline, granular, fibrous, silky, columnar, conchoidal, or laminated, according to its general appearance.

Fracture, in surgery, is the breaking of a bone. It is simple when the bone only is divided; compound when there is also a wound of the soft parts leading down to the fracture. A fracture is termed *transverse*, *longitudinal*, or *oblique* according to its direction in regard to the axis of the bone. It is called *complicated* if accompanied with dislocation, severe contusions, wounded blood-vessels, or any disease which prevents the union of the bones and causes them to be very easily broken. A *comminuted* fracture is one in which the bone is broken into several small pieces at the point of rupture. An *incomplete* fracture is one in which only a portion of the fibres is broken. A *stellate* fracture is a series of fractures radiating from a centre. When a fracture takes place, there is a pouring out of fluid—lymph—and cells from the blood contained in the vessels of

the lining membrane of the bone as well as from the vessels of the soft parts which have also suffered injury. This material surrounds the broken ends of the bone, becoming firm and consolidated. A formation of bone then takes place round the seat of fracture, and in about three weeks is hard enough to keep the broken ends in position. This is called 'provisional callus', because, when the process of repair is completed and true bone has formed to unite the break, it is reabsorbed and gradually disappears. Meanwhile a process of repair goes on between the broken ends, uniting them by the formation of true bone or 'definitive callus'.



Fractures

A, Transverse. B, Oblique. C, Spiral. D, Star-shape or stellate. E, Wedge. F, Greenstick. G, Impacted. H, Simple (skin not broken). I, Compound (skin broken).

The more quickly and accurately the broken ends are brought together after the break, the more rapid will be the reunion. The treatment of a simple fractured bone is to bring the portions into their natural position and to keep them permanently thus, by splints of some kind, pasteboard splints, for instance, dipped in warm water, with wooden ones exterior to them; or a mass of plaster of Paris may be used for the same purpose.

Fra Diav'olo, a celebrated Neapolitan brigand, whose real name was Michele Pezza. He was born in Calabria in 1760, quitted the trade of stocking-weaving for the army, and served for a time in the Papal Legion. He afterwards became a monk, but was expelled on account of misconduct. He then joined a troop of brigands, of which he became in a short time the leader. The Government set a price upon his

head; but later, having need of Fra Diavolo's service against the French, they pardoned him and gave him a colonel's commission. At the head of his band he harrassed the French, took refuge in Calabria after the conquest of Naples by Bonaparte, and incited the people against the French. He fell at last into their hands in 1806, and was executed as a robber and incendiary. Auber's opera *Fra Diavolo* has little or nothing in common with the real Fra Diavolo.

Fraga, a town of N.E. Spain, province of Huesca, on the Cinca, with a Moorish castle. It is supposed to be the Gallica Flavia of the Roman Empire. Pop. 7418.

Fragonard, Jean Honoré, French painter and engraver, born at Grasse, in Provence, in 1732, died in 1806. He studied under Chardin and Boucher, won the Prix de Rome, and then went to Italy, where he was influenced by the work of Tiepolo. Fragonard was one of the most distinguished painters of the Rococo period in France, depicting the charm, frivolity, and gaiety of the old régime. *The Bathers*, *The Sleeping Bacchante*, *The Shepherd's Hour*, *The Music Lesson*, and *The Storm* are in the Louvre; *The Swing*, *The Fair-haired Child*, *The School-mistress*, and *Le Chiffre d'amour* are in the Wallace collection.

Framboe'sia. See *Tropical Diseases*.

Framlingham, a market-town of England, Suffolk, 14 miles north-east by north of Ipswich, with extensive remains of a castle, which can be traced back to the time of Henry I. The Albert Memorial College was opened in 1865. Pop. 2400.

Franc, a modern French silver coin, but the name was given to two ancient coins in France, one of gold and the other of silver. The value of the gold franc was about half a guinea. The silver franc was in value a third of the gold one. The name was given from the device *Francorum Rex*, King of the French, on the coin, when first struck by King John II in 1300. These coins, called *francs à cheval*, disappeared during the latter half of the fifteenth century. The silver franc, or *franc d'argent*, was worth twenty *sous*, and equivalent to the *livre tournois*, and hence the use without distinction of the terms *livre* and *francs*. The modern French franc is a silver coin and money of account which since 1795 has formed the unit of the French monetary system, and has also been adopted as the unit of currency by Switzerland and Belgium. It is of the value of a little over 9½d. English, and is divided into 100 centimes. In 1920 and 1921, in consequence of the fluctuations of the rate of exchange, the value of the franc was about 4d. English.

Francavilla, several places in Southern Italy. The most important is in the province of Lecce,

14 miles w.s.w. of Brindisi. Pop. 17,750 (town); 20,510 (commune).

France (anciently *Gallia*), a maritime country in the west of Europe, forming one of its most extensive, most populous, and most influential states. It is situated between lat. $42^{\circ} 20'$ and $51^{\circ} 5' N.$; and long. $4^{\circ} 42' W.$ and $7^{\circ} 39' E.$, and is bounded north by the Straits of Dover and the English Channel; west by the Atlantic (Bay of Biscay); south by Spain and the Mediterranean Sea; east and north-east by Italy, Switzerland, Germany, and Belgium. Its greatest length from north to south is 600 miles, and its greatest breadth 550 miles. The coast-line on the whole is considerably diversified by bays, estuaries, and indentations of various kinds, and presents numerous good harbours and roadsteads. It is studded by a number of islands, especially in the north-west and west, the largest being Oléron, Ré, and Belle Isle. The total area (including Alsace-Lorraine) is 212,659 sq. miles. The capital is Paris; the other large towns in order of population are Marseilles, Lyons, Bordeaux, Lille, Strasbourg, Nantes, Toulouse, St. Étienne, Nice, Le Havre, and Rouen.

Mountains.—The interior is traversed from south-west to north-east by successive chains of mountains, commencing with the Pyrenees and including the Cevennes, the Côte d'Or, the Vosges, and others, forming the watershed, on one side of which the rivers flow west and north into the Atlantic and the English Channel, on the other side east and south into the Mediterranean. At its north-eastern extremity this system is met by the Alps and the Jura. A considerable portion of the Western Alps belongs to South-Eastern France. Mt. Blanc itself (15,781 feet) is mostly within the French boundary-line. Some lofty Pyrenean peaks are also within French territory, the highest being Vignemale (10,792 feet). Near the centre of France, and separate from the great watershed of the country, are several groups of volcanic mountains known by the general name of the Mountains of Auvergne, the chief peaks of which are the Plomb du Cantal (5983 feet), the Puy de Sancy (6100 feet), and the Puy de Dôme.

Rivers.—The spurs thrown off by the great watershed divide France into seven principal river basins, six of which are on the north-western slope and one on the south-eastern. These are: (1) The basin of the Garonne and its affluents (the Ariège, Tarn, Lot, and Dordogne on the right, and the Gers on the left); with the two secondary basins of the Charente on the north, and the Adour on the south. (2) The basin of the Loire and its tributaries (Nièvre and Maine on the right, the Allier, Loiret, Cher, Indre, Vienne, and Sèvre Nantaise on the left). (3) The basin of the Seine and its tributaries

(the Aube, Marne, and Oise on the right, the Yonne and Eure on the left). To the north is the secondary basin of the Somme. (4) The basin of the Meuse with its affluent the Sambre. (5) The basin of the Escaut or Scheldt with its affluent the Scarpe. Only the southern portion of these two basins is included within the political boundaries of France. (6) The basin which pours a number of tributaries, the principal of which is the Moselle, into the Rhine. Only a comparatively small portion of this basin also is included within the political boundaries of France. (7) The basin of the Rhône, occupying the whole of the territory which lies to the south-east of the great watershed, the tributaries being the Ain, the Saône, Ardèche, and Gard on the right, and the Isère, Drôme, and Durance on the left. The secondary basins are those of the Var and the Aude. The four great rivers of France are the Loire, Seine, Rhône, and Garonne. France has in all more than 200 navigable streams, with a total navigation of about 6000 miles. Lakes are few, and individually very limited in extent.

Geology.—Among geological formations granite holds a chief place as forming the nucleus of the mountains generally, and being the prevailing rock in the Alps, the Pyrenees, the Cevennes, and in the north-west peninsular portion of the country (Brittany). The other crystalline rocks, consisting chiefly of trachytes and basalts, have received a magnificent development in Auvergne, where whole mountains are composed of them, and where the effects of remote volcanic agency are still visible in extinct craters and lava streams. In the Jura limestone occurs in such enormous masses as to have given its name to a peculiar formation (the Jurassic). The granite is overlaid by gneiss, micaceous and argillaceous slates, succeeded, particularly in the Pyrenees, by mountain limestone. The secondary formation, commencing with this limestone, is largely developed in many parts, and furnishes a considerable number of coal- and mineral-fields. The tertiary formation covers a vast extent of surface, particularly in the south-west and around Paris.

Climate.—Lying almost wholly within the more moderate portion of the temperate zone, between the isothermal lines of 50° and 60° , France has a climate not inferior to that of any country in Europe. In the south, and particularly the south-east, which is the warmest, the olive is successfully cultivated. Farther north to a limit determined by a line drawn diagonally in an east-north-east direction from the department of Gironde to that of the Vosges, the cultivation of maize or Indian corn extends. More northward still, a line drawn from the mouth of the Loire to Mezières in the Ardennes department marks the extreme limit of the profitable culture

of the vine. Beyond this line is the fourth and coldest region. All these regions, notwithstanding their diversities of temperature, are generally healthy, and have an atmosphere remarkable for salubrity, serenity, and brightness.

Agriculture, &c.—About nine-tenths of the soil of France is productive, and about one-half of the whole is under the plough. The cereals forming the great bulk of the cultivated crops are wheat, oats, rye, and barley. The crops next in importance to these are meslin or mixed corn, potatoes, hemp, rape, maize, buckwheat, flax, and beet. Beet is cultivated extensively in some departments, especially in that of Nord, for the manufacture of sugar. The cultivation of tobacco is monopolized by the Government, and is confined to certain departments, 29 of which were authorized in 1913 to cultivate the plant. In France the grass is on a much more limited scale than the arable husbandry, and the breeding of cattle is indifferently practised. The rearing of sheep is more successful, much of the wool being scarcely inferior to merino-wool. Excellent horses are bred in the north, and as there is an extensive demand for horses for the army, considerable pains are taken in the Government studs to improve the breeds. The administration of the studs is a separate department of the Ministry of Agriculture, and it helps in various ways in the breeding of horses. The Commission of the Stud-book, instituted in 1833, and reconstituted in 1871, publishes the *Stud-book* every two years, and registers the horses admitted by the Commission. Asses and mules, generally of a superior description, are much employed. France has a very large number of vineyards. The cultivation of the vine is one of the most important branches of French agriculture, the total quantity of land in vineyards being, since 1913, about 3 per cent of the whole surface. In 1918 there were 3,812,000 acres under vines, and the total wine industry yields a net yearly total of over 2000 million francs. In everything relating to this branch of culture the French are unsurpassed, the various first-class wines which they produce under the names of Champagne, Burgundy, Bordeaux, &c., being universally known. It is estimated that in good years France produces about one-third of the whole wine production of the world. Since about 1870 the vineyards have frequently suffered from the devastations of the Phylloxera. Among the most important fruit-trees cultivated in France are the apple, from the fruit of which much cider is made, especially in Normandy; the chestnut, which in some of the central districts of France is a staple food among the poorer classes; the mulberry tree, cultivated in the south-east both for its fruit and its leaves, the latter furnishing the food of the silk-worms

so largely reared there; the olive also in the south-east; the pear, plum, peach, orange, citron, fig, &c. The forests occupy about 18 per cent of the whole territory.

Minerals.—Coal-fields are numerous, but only two are really of importance—that of Valenciennes in the north-east, forming the western extremity of the great Belgian coal-field, and that of St. Étienne in the south-east, to which the manufactures of that town, Lyons, and the surrounding districts, are much indebted. Before the European War France ranked fifth among the principal coal-producing nations, the four first being the United States, Great Britain, Germany, and Austria. The war, of course, seriously interfered with the coal-supply, and the second half of 1914 only yielded under 10,000,000 tons. The annual output, which was about 40,000,000 tons in 1913, and only 26,322,000 tons in 1918, and 21,853,000 in 1919, falls so far short of the consumption that a large import takes place from England and Belgium, and wood continues to be the common fuel throughout France, at least for domestic purposes. The coal-fields contain seams of iron, which are extensively worked, and furnish ore to a great number of blast-furnaces; but of the total amount of ore smelted in the country a considerable proportion is imported. Other metals, such as lead, zinc, manganese, copper, &c., are obtained to some extent. Common salt is obtained from mines of rock-salt, from salt-springs, and in still greater quantity from lagoons and salt-marshes on the coast.

Manufactures.—The most important of the textile manufactures is that of silk goods. This industry has been centred at Lyons and the surrounding districts since the Italian wars, and especially since the discovery of the Jacquard loom. In 1914 there were 386 silk manufactures in the seven departments of the Lyonnais region. It employs about two millions of persons, and furnishes about 27 per cent in value of the whole of the manufactured products of France. The exports of silks rose from 310,059,000 francs in 1914, to 433,292,000 francs in 1918. The principal purchaser is Great Britain, the value of French silk manufactured goods exported to the United Kingdom in 1918 amounting to 294 million francs. During the European War the French silk industry provided the military authorities with cartridge and aeroplane silk to the value of 5 million francs in 1915, 28 millions in 1916, and 50 millions in 1917. After silk goods, though at a considerable distance, follow cotton stuffs and woollens, made largely at Rheims, Amiens, and Beauvais; carpets at Abbeville; tapestry at Paris and Beauvais; linens, including fine muslin, gauze, and lace, at St. Quentin, &c.; cutlery, porcelain, stone-

ware, and common pottery, beet-root sugar, leather, paper, hats, hosiery, steel, iron, brass, and zinc ware, plate and flint glass, &c., besides many ornamental and artistic articles; jewellery, clocks, surgical instruments, types, engravings, &c., which have their common seat in the capital. The invasion of Nord and the eastern departments of France in 1914 brusquely deprived the country of its most important provinces from the industrial point of view, and its most active from the commercial. The two most vital industries of modern life, the metallurgical and textile industries, were reduced to less than half. Nevertheless, though hampered by lack of labour, raw material, and transport facilities, French industry not only kept alive during the war, but has made rapid progress since its conclusion. The fisheries of France are important. Amongst the principal is that of sardines on the coast of the Bay of Biscay; that of herring, mackerel, turbot, salmon, &c., in the English Channel and the North Sea; that of tunnies and anchovies on the coasts of the Mediterranean. Oyster-breeding is largely engaged in, the most extensive oyster-beds being those of the basin of Arcachon in the department of the Gironde. Cod-fishing is carried on actively near the Newfoundland banks by French fishermen, and also near Iceland.

Commerce.—The principal towns from which the internal commerce emanates are Paris, Lyons, Rouen, Lille, St. Étienne, Toulouse, Nîmes, Nancy, Perpignan, &c. Before the outbreak of the European War French commerce, which had been rather behindhand at the close of the nineteenth century, had made rapid progress and was only inferior to that of the United States, Great Britain, and Germany. Generally speaking, France imported more than she exported. In 1913 the total foreign commerce of France amounted to 15,301 million francs. In 1918 she imported goods for home use to the value of £892,055, and exported goods of French origin to the value of £188,097. The foreign commerce is chiefly with Britain, Belgium, Germany, and Italy. Britain is far ahead of the others, its imports from France being £48,793,000 in 1919; exports to France, £147,214,000; the former are chiefly silks, woollens, cottons, butter, wine and brandy, sugar; the latter chiefly wool and woollens, cottons and cotton yarn, coal, machinery, and metals. The shipping of France is much below what might be expected from the development of its foreign commerce, considerably more than one-half of which is carried by foreign vessels. Altogether the merchant navy of France includes 15,161 sailing vessels with a total tonnage of 561,361, and 1939 steamers of 1,066,139 tons. The chief seaports are Marseilles, Havre, Bordeaux, Rouen,

Nantes (including St. Nazaire), Dunkirk, Calais, Boulogne, and Dieppe.

Canals, Railways, &c.—The canals are numerous. The Canal du Midi, or, as it is sometimes called, the Canal of Languedoc, starting from a point in the Garonne a little below Toulouse, is continued in an east-south-east direction into the lagoon of Thau, and thereby gives a continuous navigable communication between the Atlantic and the Mediterranean, in the line of the important towns of Bordeaux, Agen, Toulouse, Carcassonne, and Narbonne. In like manner three separate canals cut across the basin of the Rhône; the Canal du Centre, or of Charollais, connecting the Saône and the Loire; the Rhône and Rhine Canal, so called from uniting these two rivers, partly by the intervention of the Doubs; and the Canal of Bourgogne, connecting the Saône, Yonne, and Seine. In all, France possesses about 3620 miles of canals in addition to about 5450 miles of navigable rivers, but a programme was recently adopted for the improvement and extension of the canal system. The railways in France partly belong to the State, and partly have been granted to private companies for a limited period, at the end of which they become State property. There are altogether 25,633 miles of railway in operation. The total length of telegraph lines is 120,471 miles.

Administration of Justice.—In accordance with the general arrangement which divides the whole country into departments, each department into arrondissements, each arrondissement into cantons, and each canton into communes, there is a series of courts, commencing with the justice of peace (*juge de paix*) of each commune, who judges in petty causes, but whose more appropriate function is understood to be to act as a kind of umpire between parties at variance, and induce them to settle their differences without proceeding to formal litigation. Failing such arrangement, the complainant brings his action before the court of first resort (*tribunal de première instance*), there being one such in every arrondissement, besides a *tribunal de commerce* in which mercantile and commercial causes are adjudicated. From these courts an appeal lies to the courts of appeal (*cours d'appel*), of which there are twenty-seven, each having jurisdiction over several departments. The most important commercial and manufacturing towns have also commercial courts (*tribunaux de commerce*), the members of which are elected by the chief business men of the respective places. Above all these courts, and properly the only supreme court of the State, is the *cour de cassation*, which has the power of reviewing and annulling the decrees of inferior courts. It sits in the capital. The *conseils de Prud'-hommes* are instituted with

the object of settling by arbitration the differences arising between commercial and industrial employers and their work-people of both sexes.

Education and Religion.—In France the superintendence of education in all its branches is expressly committed to a high functionary, who takes the name of Minister of Public Instruction and Fine Arts and is assisted by an educational council. For a good part of the eighteenth century France had only one university, the University of France, embracing a series of 'faculties' (*facultés*), which were a sort of university colleges, each specially devoted to literature, law, medicine, theology, &c. After 1896 a number of local universities were formed from these institutions, and university education is now in a flourishing state. Paris has again a university of her own, besides the Collège de France, École Polytechnique, École Normale Supérieure, École des Langues Orientales, &c. There are sixteen other universities in the following towns: Aix-en-Provence, Besançon, Bordeaux, Caen, Clermont-Ferrand, Dijon, Grenoble, Lille, Lyons, Montpellier, Nancy, Poitiers, Rennes, Toulouse, Algiers, and Strasbourg. Secondary instruction, either classical or commercial and industrial, is given by the State in the lycées, by the communes in the communal colleges, or in certain other seminaries. There are about 104 lycées, generally situated in the capitals of the departments, and about 211 colleges. Primary instruction is given in the communal schools, being compulsory and free. Religion, in like manner, was long under the cognizance of the State, falling within the province of the Minister of Justice and Religion. The State declared Roman Catholicism to be the religion of the majority, but did not establish it; on the contrary, it placed all forms of religion with more than 100,000 adherents on an equal footing, and dealt impartially with all by paying salaries to their ministers. In 1905 this arrangement came to an end, however, by the separation of Church and State. In the Roman Catholic Church are 17 archbishops and 68 bishops, not including those of Alsace-Lorraine.

Army and Navy.—Military service is obligatory upon every Frenchman who is over twenty years of age, and not pronounced unfit for military service. They have to serve first in the regular army (*armée active*), then in the reserve of the regular army for eleven years, next in the territorial army for six years, and finally in the reserve of the territorial army for six years. Before 1913 the term spent with the active army was two years, but in view of Germany's military preparations it was raised to three. In 1920 the term to be spent with the active army was reduced to eighteen months.

France will probably have an army of 350,000 men, on a peace footing, which could be raised to a war footing of 1,300,000 men. In 1918 the French army had risen to 5,000,000 men and 128,000 officers. During the European War France had altogether mobilized 7,935,000 white troops, besides 475,000 native troops. The French navy is manned partly by conscription and partly by voluntary enrolment. The effective war navy of France is of considerable strength. There is a reserve of 114,000 men of whom about 25,500 are serving with the fleet.

Finance.—Before the outbreak of the European War France was a large creditor of many foreign countries, and held some 40,000 million francs worth of foreign securities. During the war she was compelled to import merchandise of all sorts, with practically no export trade to balance matters. The result was that French stocks of foreign shares fell enormously, and France became the debtor to other lands, especially the United States and Great Britain. Before the European War her national debt amounted to £1,367,000,000; in 1920 it was £9,538,000,000. Her Budget estimate for 1921 was 24,963,000,000 francs. Her revenue in 1913 was about £189,555,297, the expenditure somewhat less. Revenue is raised by indirect and direct taxes, income tax, State monopolies, &c.

Constitution.—France has been a republic since the overthrow of the Second Empire by a Paris mob on the 4th of Sept., 1870. The details of the Constitution were fixed by a law passed by a National Assembly which met in 1871. The constitutional law, confirming the republican Government, was passed in 1875, and modified in 1879, 1884, 1885, and 1889. This law places the legislative authority in the hands of an Assembly composed of two chambers, the Chamber of Deputies and the Senate. The Chamber of Deputies is elected by universal suffrage, each *arrondissement* forming an electoral district. Proportional representation was adopted in 1919. The total number of Deputies is now 610. The Deputies are elected for four years. The Senate consists of 314 members (22 for Alsace-Lorraine), of whom 75 were originally elected for life; but in 1884 it was enacted that vacancies among the life senatorships should be filled up as they arose by the election of ordinary nine-year Senators. Both Senators and Deputies are paid 15,000 francs per annum, and travel free on all railways by means of a small annual payment. The head of the State is a President, elected for seven years by a majority of votes of the members of the two chambers sitting as one. The President is assisted by a body of ministers appointed by him. He has the appointment to all civil and military posts.

Weights, Measures, and Money.—The unit of the French monetary system is the franc (of the exchange value of about 9*d.*), which is divided decimally. The system of weights and measures is also decimal, the units with their English equivalents being as follows: the mètre = 39·37 inches or 3·28 feet; the kilomètre, or 1000 mètres = 1093·6 yards or ·621 of a mile; the are, the square of 10 mètres = 1076·441 sq. feet; the hectare, or 100 ares = 2·47 acres; the square kilomètre = ·386 of a sq. mile; the stère or cubic mètre = 35·317 cubic feet; the litre = 1·76 pints; the hectolitre, or 100 litres = 22·0097 gallons; the gramme = 15·4323 grains; the kilogramme or 1000 grammes = 2·205 lb.

Political Divisions and Extent of Empire.—Before the Revolution of 1789 France was divided into general governments or provinces, the number of which varied at different epochs. Under Francis I, by whom they were instituted, there were nine, namely, Normandie, Guyenne, Languedoc, Provence, Dauphiné, Bourgogne, Champagne-et-Brie, Picardie, Île de France. Under Henry III there were twelve, formed by the addition of Bretagne, Orléanais, and Lyonnais. Under Louis XIV the number was fixed at thirty-two, to which a thirty-third was added by the acquisition of Corsica under Louis XV. At the Revolution the whole of France, including Corsica, was parcelled out into departments, and each department subdivided successively into arrondissements, cantons, and communes. This division, carried out in 1790, has since maintained its ground. The number of departments was originally eighty-three, but it has been at different times increased and decreased. There are now ninety departments, including the three departments of Alsace-Lorraine transferred to France by the Peace Treaty of 28th June, 1919. These three departments are: Bas-Rhin, Alsace, Haut-Rhin, and Moselle. The average area of each is about 2300 sq. miles (more than one-third that of Wales). The total area added to France as a result of the European War was 5605 sq. miles. In addition to the territory it occupies in Europe, France possesses (either absolutely or as protectorates) Algeria, Tunis, Senegambia, Ivory Coast, Dahomey, &c., parts of the Sahara, Sudan, and of the Congo region, Réunion, Madagascar, and other East African islands; Cochín-China, Tonquin, Annam, and other possessions in Asia; French Guiana, in South America, with the Islands of Guadeloupe, Martinique, &c.; New Caledonia, Tahiti, &c., in the Pacific. The total area of France and her dominions is therefore as follows: France (including Alsace-Lorraine) 212,659 sq. miles; pop. 41,475,523; colonies and dependencies, 4,500,000 sq. miles; pop. about 41,000,000.

History.—France or Gaul, at the earliest period of which anything is known with regard to it, was inhabited by a number of independent tribes, who appear to have been mainly Celtic in race. In the latter half of the second century B.C. the Romans conquered a portion of the south-east, and under Julius Cæsar the conquest of all Gaul was completed between 58 and 51 B.C. (See *Gaul*.) Subsequently the country became completely Romanized in language, civilization, and religion, and many flourishing towns sprang up. In the decline of the Roman Empire German tribes began to make settlements in Gaul, and it was from a body of these, known as *Franks*, that the name France arose. Towards the end of the fifth century Clovis, chief of the Salian Franks, made himself master not only of almost all France (or Gaul), but also of a considerable territory east of the Rhine. The dynasty which he founded was called the Merovingian from his grandfather Merovæus. Clovis died in 511, leaving his kingdom to be divided amongst his four sons, as subsequent rulers often did. The Frankish dominions were thus differently divided at different times; but two divisions, a western and an eastern, or Neustria and Austrasia, became the most important. A large part of the history of the Franks under the Merovingian kings is the history of the contests between these two states. Afterwards Pippin or Pépin d'IIéristal, mayor of the palace of the Austrasian king, conquered Neustria and made his sway supreme throughout the kingdom of the Franks. This date may be regarded as that of the real termination of the Merovingian line, for although kings belonging to this family continued to be crowned till 752, they were mere puppets, *rois fainéants* as they are generally called: the real power was in the hands of the mayors of the palace. Pépin died in 714. He was succeeded, after a brief period of anarchy, by his son Charles Martel, or Charles the Hammer—a title he earned by the courage and strength he displayed in battle. During his tenure of power all Europe was threatened by the Saracens, who, after occupying Spain, had penetrated into France, and were met by Charles Martel on a plain between Tours and Poitiers, and totally defeated (732). Charles Martel died in 741, leaving Austrasia and the countries beyond the Rhine to his son Carloman, and Neustria and Burgundy to his son Pépin the Short. On his brother's death Pépin seized his heritage, and in 752, thinking it time to have done with the system of *rois fainéants*, had himself crowned King of the Franks. In 768 he died, and was succeeded by his sons Charles, afterwards known as Charlemagne (Charles the Great), and Carloman. The latter dying in 771, Charlemagne then became sole ruler, and conquered and organized an

empire which extended from the Atlantic on the west to the Elbe, the Saale, and the Bohemian Mountains on the east, and embraced also three-fourths of Italy, and Spain as far as the Ebro. By Pope Leo III on Christmas Day in the year 800 he was crowned in the name of the Roman people as Emperor of the West. There was as yet, strictly speaking, no kingdom of France, and Charlemagne was a German, and his empire (the *Holy Roman Empire*) a German one.

To Charlemagne succeeded in 814 his youngest son Louis the *Pious*. At the death of the latter the empire, after many disputes, was eventually divided by the Treaty of Verdun in 843 amongst his sons, the portion nearly corresponding to modern France falling to Charles the Bald. From this time the separate history of France properly begins, the history of the French language being also traced to the same period, while the eastern portion of the old Frankish territory remained German. After Charles the Bald, the first of the Carolingian kings, had been succeeded in 877 by Louis II, and Louis II by Louis III (879-882) and Carloman (879-884), Charles the Fat, king of the eastern Frankish territory, became ruler of the western also till 887, when he was deposed. After a brief usurpation by Eudes, Count of Paris, Charles III, the brother of Louis III, was recognized as king. But his kingship was little more than nominal, France being divided into a number of great fiefs, the possessors of which, though acknowledging the feudal supremacy of Charles, were practically independent. In these circumstances Charles, unable to offer any adequate resistance to the Norman pirates who were devastating the coast and making incursions into French territory, surrendered to them, in 912, the province which took from them the name of Normandy. Towards the end of his reign Hugh of Paris, as he is generally called, Duke of France, was really the most powerful person in the kingdom, and throughout the reigns of Louis IV, Lothaire, and Louis V, he and his son Hugh Capet held the real power. On the death of Louis V without children in 987 Hugh Capet mounted the throne himself, and thus became the founder of the Capetian dynasty. The great fiefs of Paris and Orleans were thus added to the Crown, and Paris became the centre of the new monarchy.

The first task of the Capetian line was to reconquer the royal prerogatives from the great vassals, but for two centuries they had little success. Hugh Capet died in 996, and his first three successors, Robert (died 1031), Henry I (died 1060), and Philip I (died 1106), effected nothing whatever towards the establishment of the royal authority. Louis VI was more successful, being greatly helped by the fact that

the nobility had been much weakened by the Crusades. The growth of the towns also, which ultimately became the allies of the kings, was a powerful check on the nobles.

Louis VI died in 1137, and was succeeded by his son Louis VII, who reigned till 1180. During his reign the stability of the French throne was endangered by the influence acquired in France by Henry II of England, who possessed, either by inheritance or by his marriage with Eleanor of Aquitaine, the whole of the west of France except Brittany. Louis was succeeded by his son Philip Augustus (Philip II), who did much to strengthen the throne, depriving John, King of England, of Normandy, Maine, and Anjou. His son Louis VIII, who succeeded in 1223, carried on the work by the conquest of Poitou, and a religious war being proclaimed against the Counts of Toulouse, who protected the Albigenses, that House was extinguished, and their domains passed to the royal family. Louis VIII died in 1226, and under the wise rule of Louis IX (St. Louis) the influence of the Crown went on increasing, as it did also under Philip (III) the Bold (died 1285), Philip (IV) the Fair (died 1314), Louis X (died 1316), John I (died 1316, after a reign of five days), Philip V (died 1322), and Charles IV (died 1328), by the acquisition of fresh domains and other means until the outbreak of the wars with England.

The first branch of the Capetian line of kings became extinct on the death of Charles IV, the last of the sons of Philip the Fair, the Salic law excluding the female succession. The crown thus fell to Philip of Valois, a cousin, who became king as Philip VI. His claim was disputed by Edward III of England, and the dispute led to a series of wars which were not terminated for more than 120 years. During this period France was reduced to a state of great misery. While Edward, victorious over Philip VI, and after his death over John (II) the Good, who was taken prisoner at Poitiers in 1356, compelled the surrender to England of some of the finest provinces of France by the Treaty of Brétigny in 1360, the country was plundered by *banditti*, and the *Jaquerie*, a mass of furious peasants (about 1358), satiated their spirit of vengeance with the blood of the nobility. Charles (V) the Wise, who succeeded John the Good in 1364, and his constable, Du Guesclin, were able to restore order only for a short time, although during this reign the English were driven out of most of their possessions in France. Then came the long and unhappy reign of the imbecile Charles VI (1380-1422), during which Henry V of England, reviving the claim of Edward III to the French crown, invaded France, won the field of Agincourt, and obtained a treaty (Treaty of Troyes) which secured the

right of succession to the French crown for himself and his descendants. Charles VI died in 1422, a few weeks after Henry V, whose son, Henry VI, a minor, was acknowledged as king by the greater part of France. But between 1420 and 1431 the peasant girl *Joan of Arc* animated the French in the cause of the dauphin, who was crowned as Charles VII at Rheims in 1429, and in 1451 the English had lost all their possessions in France, except Calais. The shrewdness and perfidy of Louis XI (1461-88) completed the subjugation of the great

his death the crown reverted to another branch of the House of Valois, that of Angoulême, Francis I (1515-47) being the grandson of John, Count of Angoulême, uncle of Louis XII. Francis I still continuing the attempts at conquest in Italy, was brought into conflict with Charles V of Germany, who also claimed Milan as an imperial fief. The result was five wars between France and Germany, in the first of which Francis had to retreat across the Alps; in the second he was taken prisoner at Pavia; in the third he seized Savoy and Piedmont, which the Peace of Crespy (1544), made at the conclusion of the fourth war, allowed him to keep.

Francis I died in 1547, and his son, Henry II (1547-59), pursuing the same policy, renewed the war for the fifth time with the House of Habsburg. In the Peace of Cateau-Cambrésis (1559), with which it ended, Henry had to surrender Savoy and Piedmont, but remained in possession of the German bishoprics of Metz, Toul, and Verdun. The year before, Calais, the last English possession in France, had been captured by Francis, Duke of Guise. Francis II, the husband of Mary Queen of Scots, succeeded his father Henry, but reigned little more than a year (1559-60). The foundation of the national debt, the weight of which broke down the throne 250 years later, was laid in this period. Intrigue and corruption gave to women a dangerous influence at court and in public affairs. Under the administration of Charles IX (conducted during his minority by the queen-mother, Catherine de' Medici) France was inundated with the blood of Frenchmen, shed in the religious wars from 1562. (See *Bartholomew, Massacre of St.*) These continued throughout the reign of Charles IX and his successor, Henry III (1574-89), and were only terminated when Henry IV, originally King of Navarre, and since the death of Henry III King of France, went over to the Catholic Church (1593), having hitherto been the leader of the Huguenots.

Henry IV was the first French sovereign of the House of Bourbon, which inherited its right to the throne from a son of Louis IX. He united to the Crown of France the kingdom of Navarre, which he had inherited from his mother, Jeanne d'Albret. In his government of France Henry showed all the qualities of a great prince and a great statesman, establishing religious toleration (Edict of Nantes, 1598), and labouring diligently for the welfare of the State. He was cut off prematurely by the dagger of the fanatic Ravalliac (1610). During the minority of Henry's son, Louis XIII, the French policy was at first wavering, until the Prime Minister, Cardinal Richelieu, gave it a steady direction. He restored the French influence in Italy and the Netherlands, humbled Austria and Spain, and



barons, and laid the foundation of absolute monarchy. Maine, Anjou, and Provence were left to him by the will of the last count, and a large part of the possessions of the Duke of Burgundy, including Picardy, Artois, the duchy of Burgundy proper, and Franche Comté, all came into his hands not long after the death of Charles the Bold, in 1477. His son and successor, Charles VIII (1483-98), also united Brittany to the Crown by his marriage with Anne, the heiress of the fief, and effected a conquest of Naples, which lasted but a short time.

Charles was the last king of the direct line of Valois, which was succeeded by the collateral branch of Valois-Orleans (1498), in the person of Louis XII, who was descended from Louis of Valois, Duke of Orleans, brother of Charles VI. In order to keep Brittany attached to the Crown he married the widow of his predecessor. On

created that domestic government which rendered the Government completely absolute.

Louis XIII died in 1643, the year after his great minister, and was succeeded by Louis XIV, 'le Grand Monarque'. The policy of Richelieu was carried on by Mazarin during the regency of Anne of Austria, while Louis was still a minor, and also for some years after Louis was declared of age. During his ministry France obtained by the Peace of Westphalia (1648) the German province of Alsace, and by the Peace of the Pyrenees (1659) parts of Flanders, Hainault, Luxembourg, &c. After the death of Mazarin, in 1661, Louis XIV took the government into his own hands, and ruled with an absolute sway. The period which immediately followed was the most brilliant in French history. His ministers, especially Colbert, and his generals, Turenne, Condé, Luxembourg, and the military engineer Vauban, were alike the greatest of their time; the writers of the period were also among the greatest in French literature. An unsuccessful attempt was made on the Spanish Netherlands; a war was undertaken against Holland, Spain, and Germany, which ended in France receiving Franche Comté and other places from Spain, and Freiburg from Germany. In 1681 Strasbourg was seized from the empire in a time of peace. The last war of Louis was the War of the Spanish Succession (1701-14), which resulted unfortunately for France. During this reign great injury was done to French industry by the revocation of the Edict of Nantes in 1685. Louis XIV died in 1715, leaving the finances in disorder, and a national debt amounting to no less than 4,500,000,000 livres. Louis XV, the great-grandson of Louis XIV, succeeded at the age of five years. During his minority the regent, the Duke of Orleans, squandered the revenues in the most reckless manner, and matters went from bad to worse. In 1723 Louis was declared of age, but he sank under the pernicious influences of mistresses like Pompadour and Du Barry into extravagance and licence, entering into useless and costly wars (War of Austrian Succession, 1740-8; Seven Years' War, 1756-63), and contracting enormous debts. During this reign two important acquisitions were made by France, namely, Lorraine and Corsica.

With the reign of Louis XVI began the period of expiation for the misdeeds of the French monarchy and aristocracy, which had culminated in the preceding reign. The king himself was amiable, but the whole administration was rotten, and the court, the nobility, and the clergy formed only one privileged class united to oppress the people. The good intentions of Louis were neutralized by a total lack of energy and firmness. The first difficulty of his Government, and the rock on which it split, was the

hopeless condition of the public finances, with which Turgot, Necker, Calonne, Brienne, and again Necker tried in vain successively to grapple. Finding all ordinary measures unavailing, Necker demanded the convocation of the States General, which had not met since 1614. They met on 5th May, 1789, but as the nobles and clergy refused to give the Third Estate its due weight in the conduct of business, the Deputies of this body assumed the title of the National Constituent Assembly, and resolved not to separate till they had given a Constitution to France. The clergy and nobles then yielded, and the fusion of the three orders was effected on 27th June. Foreign troops, however, were brought to Paris to overawe the Assembly. The people now demanded arms, which the municipality of Paris supplied; and on 14th July the Bastille was captured and destroyed. Lafayette was made commander of the newly established National Guard. On the 4th Aug. a decisive step was taken by the abolition of all feudal rights and privileges. On 5th Oct. Versailles was attacked by the mob, and the royal family, virtually prisoners, were taken to Paris by Lafayette. The king tried to obtain the aid of some of the foreign powers against his subjects, and made his escape from Paris (20th June, 1791); but he was recognized, arrested at Varennes, and brought back to Paris. On 30th Sept., 1791, the Assembly brought its work to a finish by producing a new Constitution, which was sworn to by the king on 14th Sept., and he was then reinstated in his functions. This Constitution deprived the king of arbitrary powers, provided liberty of worship and freedom of the press, of commerce, of industry; abolished the laws of primogeniture and entail as well as titles; all France was redivided into eighty-three departments, nearly equal in extent.

The Constituent Assembly was, according to the Constitution, immediately followed by the Legislative Assembly, which met on 1st Oct., 1791, and in which there were two parties of political importance, the Girondists, moderate republicans, so named because their leaders came from the department of the Gironde, who led it, and the Montagnards, extreme radicals, known collectively as the Mountain, because their seats were the highest on the left side of the hall, who subsequently became all-powerful in the Convention. The constitutionalists and monarchists were already powerless. The declaration of Pillnitz by the Emperor of Germany and the King of Prussia, threatening an armed intervention on behalf of the king, compelled the Assembly to take a decisive course, and on 20th April, 1792, war was declared against Austria and Prussia. Reverses to the French troops caused a popular rising, and the Tuileries, after

a sanguinary combat, were taken and sacked. The king took refuge with his family in the Assembly, which was invaded and compelled to submit to the dictation of the victors by assenting to the suspension of the king and the convocation of a National Convention in place of the Assembly. The first act of the Convention was to proclaim a republic. On 3rd Dec. the king was cited to appear before it. On 20th Jan., 1793, he was sentenced to death within twenty-four hours, and on the 21st the sentence was executed. This violent inauguration of the republic shocked public opinion throughout Europe, and armed the neutral states against France. England, Holland, and Spain joined the coalition. The extremists in France only grew more violent, a Committee of Public Safety, with sovereign authority, was appointed 6th April, and the Reign of Terror began. The struggle between the Girondists and the Montagnards or Jacobins terminated in favour of the latter. A new Constitution was adopted by the Convention on 23rd June, called the Constitution of the Year I, the Republican Calendar being adopted on 5th Oct., 1793, the year I beginning on the 22nd of Sept., 1792. Christianity was formally abolished. Risings against the Government were put down with frightful bloodshed. Both in Paris and the provinces executions and massacres of persons alleged to be disaffected to the party in power followed each other daily. The queen was executed on 16th Oct., 1793, the Girondists on 31st Oct., and others followed, Robespierre being foremost in the bloody work. At length the Reign of Terror came to an end by the execution of Robespierre and his associates on 27th and 28th July, 1794. Danton and Hébert, his old allies, he had already brought to the scaffold. Marat, another man of blood, had perished by assassination. The campaigns of 1793 and 1794 resulted favourably to the French arms, which were carried beyond the French frontier, Belgium and Holland being occupied, Spain being invaded, and the Allies being driven across the Rhine. These successes induced Prussia and Spain to sign the Treaties of Basel (1795), recognizing the French Republic. In 1795 the Convention gave the republic a new Constitution, a chamber of *Five Hundred* to propose the laws, a chamber of *Ancients* to approve them, and an executive of five members, one elected annually, called the *Directory*. The Convention was dissolved on 26th Oct.

Napoleon Bonaparte now began to be the most prominent figure in French affairs; and after his brilliant successes against the Austrians both north and south of the Alps, and his empty conquest of Egypt, it was not difficult for him to overthrow the government of the *Directory*. This was accomplished in the revolution of 18th

and 19th Brumaire (9th–10th Nov., 1799), the Directory being succeeded by the Consulate, Bonaparte himself being appointed *First Consul* for ten years. The other two Consuls, Cambacérès and Lebrun, were to have consultative voices only. The new Constitution (Constitution of the year VIII, originally devised by Siéyès) was proclaimed on 15th Dec. Under the appearance of a republic it really established a military monarchy. The history of France for the next sixteen years is virtually the history of Napoleon (q.v.). In 1802 the Constitution was amended, Napoleon being made Consul for life, with the right of appointing his successor. In 1804 he was proclaimed Emperor, this being confirmed by a popular vote of 3,572,329 against 2569. The emperor was consecrated at Paris by Pius VII, and in 1805 he was also crowned King of Italy. For years the continental powers, whether singly or in coalitions, were unable to stand against him, though at sea France was powerless after the great victory by Nelson over the French and Spanish fleets at Trafalgar (1805). The Austrians and Russians were decisively defeated at the great battle of Austerlitz (1805); the King of Naples was dethroned, and Napoleon's brother Joseph put in his place; another brother, Louis, was made King of Holland; while for a third, Jerome, the Kingdom of Westphalia was erected (1807). Prussia was conquered, and compelled to accede to humiliating terms. Napoleon was at the height of his power in 1810 and 1811, his empire then extending from Denmark to Naples, with capitals at Paris, Rome, and Amsterdam. By this time, however, the Peninsular War (q.v.) had broken out, which was one immediate cause of his downfall, the disastrous Russian campaign of 1812 being another. The latter cost the French the loss of at least 300,000 men. A new coalition was now formed against Napoleon, and in 1813 he was disastrously defeated by the Allies at the great battle of Leipzig. By this time the Peninsular War was drawing to a close, and Southern France was actually invaded by Wellington. The Allies entered Paris on 31st March, 1814. Napoleon abdicated, and received the Island of Elba as a sovereign principality. Louis XVIII was proclaimed King of France, and concluded the Peace of Paris (30th May, 1814). A congress of the Great Powers had assembled at Vienna to adjust European affairs, when it was announced that Napoleon had left Elba, returned to Paris 20th March, 1815, and been reinstated without resistance in his former authority. The allied sovereigns proclaimed him an outlaw, and renewed their alliance against him. Napoleon, anticipating the attack, crossed the Sambre with 130,000 men, defeated Blücher in the battle of Ligny, and marched against the British, who

had taken position at Waterloo. Here on the 18th was fought the decisive battle which resulted in his final overthrow. On the 7th July the Allies entered Paris for the second time. Napoleon surrendered to the British, and was sent to St. Helena as a prisoner.

Louis XVIII at first governed with the support of a moderate Liberal party, but the reactionary spirit of the aristocrats and returned émigrés soon got the upper hand; the country, however, was prosperous. Louis having died 16th Sept., 1824, his brother, Charles X, succeeded. On 26th July, 1830, the Polignac ministry, strongly reactionary in its tendencies, published ordinances suppressing the liberty of the press and creating a new system of elections. The result was an insurrection during the three days 27th–29th July, by which Charles X was overthrown and Louis Philippe of Orleans proclaimed king 9th Aug., 1830. During the last days of Charles X's reign a French expedition had captured the city of Algiers and laid the foundation of the French colony there. During the eighteen years of Louis Philippe's reign the chief events were the taking of the Citadel of Antwerp, the temporary occupation of Ancona, both in 1832, and in 1835 the completion of the conquest of Algeria. But afterwards, under the ministry of Guizot, a policy of resistance to all constitutional changes was adopted, and a strong opposition having been formed, on 24th Feb., 1848, another revolution drove Louis Philippe into exile. A republic was proclaimed, and on the 10th Dec., 1848, Louis Napoleon, nephew of the great Napoleon, was elected President for four years. The President, having gained the favour of the army, dissolved the Legislative Assembly on 2nd Dec., 1851, put down all resistance in blood, and by this *coup d'état* established himself as President for the further term of ten years. A plebiscite of 7,839,216 votes confirmed the appointment. On 2nd Dec., 1852, the President was declared emperor under the title of Napoleon III (a son of the great Napoleon being counted as Napoleon II); and a plebiscite of 7,824,129 votes was again got to confirm the appointment. The Crimean War (1854–6) and the war against Austria on behalf of Italy (1859) distinguished the early part of his reign. The latter greatly aided in the foundation of a United Italy, and gave France the territories of Savoie and Nice (1860). In 1870 the uncasiness of Napoleon and the French at the steady aggrandizement of Prussia broke out into flame at the offer of the Spanish crown to a prince of the House of Hohenzollern. France, not satisfied with the renunciation of the German prince, demanded a guarantee from the King of Prussia that the candidature should never be resumed. This being refused, France declared

war. (See *Franco-German War*.) One French army was driven back by the Germans and cooped up in Metz, another was pushed northwards to Sedan, and so hemmed in that it had to surrender with the emperor at its head. On the news of this disaster reaching Paris the Republic was proclaimed. After an almost uninterrupted series of victories the Germans became masters of the French capital (28th Jan., 1871), and the war ended in France giving up to Germany Alsace and a part of Lorraine, and paying a war indemnity of five milliards of francs (£200,000,000). Meanwhile civil war had broken out in Paris, which was suppressed with great difficulty. (See *Commune of Paris*.) The Assembly elected in 1871 for the ratification of peace with Germany found it expedient to continue their functions, Thiers being the head of the administration. In 1873 the Thiers administration was overthrown and replaced by one under Marshal MacMahon. In 1875 a republican Constitution was drawn up. In 1879 MacMahon resigned his presidency before its legal expiry, being succeeded by Jules Grévy, who was followed by Carnot (assassinated), Casimir-Perier, Faure, Loubet, Fallières, Poincaré, Deschanel, and Millerand. In 1881 France occupied Tunis as a protectorate; in 1883–4 she extended her influence over Tonquin and Annam; in 1895 she reduced Madagascar to submission.

Since the establishment of the republic the reactionary and royalist parties have never disarmed, but all their endeavours to overthrow the republic have failed. One of the principal crises which threatened France in modern times was that of Boulangism. General Boulanger had become so popular that for a moment it was thought he would form a new Government. The parliamentary republic, however, triumphed. This happened in 1889, and ten years later the Dreyfus Affair once more divided France into two camps. Dreyfus, however, was at last proved to be innocent, and the reactionary party was weakened. Many reforms, social and religious, were the result of the activity of the Republican Government, one of the chief being the separation of Church and State in 1905. Abroad France steadily pursued her policy of colonial expansion. In 1891 France concluded an alliance with Russia, which was strengthened between 1899 and 1906 when Delcassé was Minister for Foreign Affairs. Cordial relations were also established with Italy, thus weakening the Triple Alliance. In 1904 an Anglo-French agreement was concluded, and France obtained territorial concessions in West Africa, and the right to maintain order in Morocco. The Algeiras Conference of 1906 decided that France should be given certain customs rights on the Algerian frontier. Germany protested in 1908

de Roland (Song of Roland). Of the Arthurian cycle, the *Roman de Rou* and *Roman de Brut*; and of the Alexandrine cycle, the *Alexandre* by Lambert li Cors, and *La Guerre de Troie* (War of Troy) by Benoît de St. More, are examples. Out of the *chansons de geste* grew the *romans d'aventures*, fictitious poems which are not connected with any of the well-defined topics of the *chansons de geste*. Distinct from these are the *fabliaux*, metrical tales of a witty, sarcastic kind, belonging mostly to the twelfth or thirteenth centuries. Allied to these is the *Roman de Renard* (History of Reynard the Fox), a poem, or rather series of poems, written between the end of the twelfth and the middle of the fourteenth century, and forming a satirical picture of all the classes and institutions of the time.

Side by side with these epics, romances, and tales, an abundant lyric poetry flourished from the eleventh century. This song literature is mainly of a sentimental character, and is usually divided into two classes, *romances* and *pastourelles*. It is in general remarkable for its lyric grace and skilful melody. Amongst the principal of the early lyrists are Thibaut de Champagne (1201-53) and Charles of Orleans (1391-1405). The latter, a graceful writer of ballades and rondels, was amongst the last of the real Trouvères. Rutebeuf (born 1230), also a writer of *fabliaux*, is the first of a series of poets, culminating in François Villon, who passed their life in a Bohemian alternation of gaiety and misery, celebrating each phase with equal vigour in verse. The *Roman de la Rose*, the work, in its earlier part, of Guillaume de Lorris, who lived in the first half of the thirteenth century, in the later, of Jean de Meung (died 1320), is one of the most notable productions of the time. It consists of more than 22,000 verses, and is a curious combination of a love poem and a satire. Olivier Basselin (who died about 1418) wrote songs celebrating the praises of wine. François Villon (1431-1500), the greatest of French poets before the Renaissance, wrote two compositions known as the *Great* and the *Little Testament*, interspersed with lyrical compositions of great poetic merit.

In prose literature the first important work is the *Histoire de la conquête de Constantinople* by Villehardouin (1167-1213). The *Mémoires* of the Sieur de Joinville (1223-1317) delineates the life of St. Louis and the exploits of the last Crusade. Froissart (1337-1410), the 'Herodotus of his age', gives a vivid picture of the chivalry of the fourteenth century. With Philippe de Commines (1445-1509) we are introduced to Louis XI and his contemporaries in a style of history which, if less naïve and charming, shows a deeper and more philosophical sense of things.

In lighter prose the *Cent Nouvelles Nouvelles* already shows the power of the French language for the short, witty tale.

The revival of classical learning and the reformation of religion exercised a powerful influence on the French literature of the sixteenth century. Rubelais (1483-1553), a profound but often gross humorist, and Montaigne (1533-92), an interesting and instructive, though somewhat sceptical essayist, hold the first rank. Calvin (1509-64) did much by his great theological work, *Institution de la religion Chrétienne*, to mould French prose in the direction of strength and gravity. Amongst the other works which indicate the rapid development of French prose in this century are Brantôme's *Mémoires*, the *Heptaméron* of Queen Margaret of Navarre (1492-1549), the translations by Amyot (1513-93) of Plutarch and other classic writers, and the celebrated political pamphlet, *Satire Ménippée*. In poetry Clement Marot (1497-1544) gave a new elegance to the language in his epistles and epigrams. Pierre de Ronsard (1524-85) and the other members of the celebrated *Pléiade*, Jodelle, Belleau, Du Bellay, and others, sought to enrich their native tongue by the introduction of classic words, constructions, and forms of verse. Du Bartas (1544-90) and D'Aubigné (1550-1630) carried on the work of Ronsard. Mathurin Régnier (1573-1613) may be said to close this school of poetry. He unites in himself the lighter qualities of the style of Villon and Marot, with the erudition and command of language characteristic of the Ronsardists. Malherbe (1556-1628), the creator of a new taste in literature, opposed with success the tendency of the Ronsard school, and, falling into the opposite excess, sacrificed everything to correctness. It was his school that set the example of the smooth but monotonous Alexandrine. With the Renaissance translations of the classic dramas appeared, and a member of the *Pléiade*, Jodelle (1532-1573), wrote the first regular tragedy (*Cléopâtre*) and comedy (*Eugène*).

The seventeenth century opened with Alexandre Hardy (1560-1631), Rotrou (1609-50), Tristan (1601-55), Mairet (1604-88), Du Ryer (1605-48), and a host of other dramatists, for nearly a hundred can be enumerated in the first quarter of the century. At length Pierre Corneille (1606-84), with his *Cid*, *Cinna*, *Horace*, and *Polyeucte*, brought French tragedy to a degree of grandeur which it has never surpassed. Of seventeenth century prose writers Pascal (1628-62) is vigorous and satirical in his *Lettres Provinciales*; profound, if sometimes mystical, in his *Pensées*. The letters of Balzac (1594-1654) and Voiture (1598-1648), though rhetorical, are good examples of polished prose. Descartes (1596-1650) showed in his *Discours sur la*

méthode that the language was now equal to the highest philosophical subjects, and the great work of his disciple, Malebranche, *Recherche de la vérité*, is equally admirable for its elegance of style and its subtlety of thought.

The age of Louis XIV is known as the golden age of French literature. Besides Corneille, Racine (1639-99) represented the tragic drama, and Molière (1622-73) brought his great masterpieces of comedy on the stage. The 'inimitable' La Fontaine (1621-95) produced his *Contes* and the most charming collection of fables. For his critical influence, if not for his poetry, Boileau (1636-1711) holds a prominent place. In eloquence the sermons and funeral orations of Bossuet, Bourdaloue, and Massillon take the first rank. Bossuet is also celebrated as a controversialist and theological historian. Very important, too, are the memoir and maxim writers of this time. Amongst the former are the Cardinal de Retz, Madame de Motteville, Madame de Sévigné (1627-96), and others; amongst the latter are La Rochefoucauld (1613-80), St. Evremond (1613-1703), La Bruyère (1630-99). In fiction Le Sage, who also wrote comedies, produced his immortal *Gil Blas* and the *Diable Boiteux*; and the versatile Fontenelle wrote his *Dialogues des morts*.

Amongst the writers of the eighteenth century Voltaire holds the first place. He claims notice as an epic, lyrical, and comic poet, as a tragic and comic dramatist, historian, novelist, and philosopher, and he remained at the head of the republic of letters for more than half a century. Next to him in immediate influence on the age stands Jean Jacques Rousseau (1712-78), a writer of an eloquent sentimental vein, well represented by his *Nouvelle Héloïse* and his famous *Confessions*. His new theories of politics and education are embodied in his *Contrat Social* and *Émile*. Buffon (1707-88) devoted himself to the production of his immense natural history. Montesquieu (1689-1755), commencing with the *Lettres Persanes*, a satire on French manners and government, followed with an historical masterpiece, *Considérations sur la grandeur et la décadence des Romains*, and finally with his great work, the *Esprit des Lois*. Diderot (1713-83), a powerful and suggestive writer in many departments, and D'Alembert (1717-83), a great geometer, founded the *Encyclopédie*, a vast review of human knowledge, often hostile to social order and always to religion. Amongst the philosophers Helvetius, D'Holbach, and La Mettrie represent the extreme materialistic and anti-Christian school. Condillac and Condorcet kept most on the side of moderation. Among the writers of fiction Bernardin de St. Pierre (1737-1814), author of *Paul et Virginie*, and Prévost (1697-1763), author of *Manon Lescaut*,

are particularly worthy of mention; while dramatic literature was enriched by the *Barbier de Séville* and the *Mariage de Figaro* of Beaumarchais (1732-99). The age was not poetical; poetry had degenerated into imitations of foreign descriptive poets, such as Thomson. The most successful writer of this stamp was Delille (1738-1813). André Chénier (1762-94), the most promising of all, fell beneath the guillotine just after completing his *Jeune Captive*.

Neither the Revolution nor the First Empire was favourable to literature. Chateaubriand (1768-1848) and Madame de Staël (1766-1817) gave a new turn to the taste and sentiment of the time, the former in his *Génie du Christianisme* and his *Martyres*, clothing the history of Christianity in the romantic hues of his imagination, the latter in her *Corinne* and *De l'Allemagne* introducing the idealistic spirit and thought of the Germans to her countrymen. A purely reactionary school of thought was headed by Joseph de Maistre (1754-1821), the advocate of theocracy, with a vigorous despotism for its system of government.

Later on in the nineteenth century the influence of Goethe, Schiller, Shakespeare, Scott, and Byron began to be felt, and a new school, called the *Romantic*, as opposed to the old or *Classic*, sprang up, headed by Victor Hugo (1802-85), who promulgated the new theories in the preface to his drama of *Cromwell*, and carried them into practice in numerous poems. The most notable of his associates were Alfred de Vigny (1797-1863), author of a volume of *Poèmes*, and of a novel, *Cinq-Mars*; Sainte-Beuve (1804-69), who published several volumes of poetry in those early days, but became famous later on as a critic, perhaps the best France has ever possessed; and Alfred de Musset (1810-57), who produced some of the finest lyrics in the language. Charles Nodier, Gérard de Nerval, the two Deschamps, and, later, Théophile Gautier, with others, also belonged to the band of romanticists. On the stage the dramas of Alexandre Dumas, the elder (1803-74), though melodramatic and of inferior literary value, served as rallying points for the new school. To English readers, however, he is best known by his novels. A reactionary movement was attempted, led by Ponsard (1814-67) and Émile Augier (1820-89). Casimir Delavigne (1793-1843) attempted to combine the Classic and Romantic schools; and Lamartine (1790-1869) is more than half a romanticist by sentiment and style. Béranger (1780-1857), the greatest of French song-writers, may be considered as belonging to neither of the two schools, nor can the machine-made comedies and vaudevilles of Eugène Scribe be claimed by any of the rival parties.

Among novelists, Balzac (1799-1850), by his

series of realistic novels, known by the comprehensive name of *La Comédie Humaine*, has established his claim to the first place. The novels of George Sand (Madame Dudevant, 1804-76), perhaps equally famous, have gained her the reputation of possessing the finest style of any contemporary writer. Low life in Paris was vividly depicted by Eugène Sue (1804-57) in the *Mystères de Paris*, &c. Of a healthy tone are the novels of Frédéric Soulié, Émile Souvestre, and Edmond About (1828-85), and the stories of the two novelists, conjoined in work as in name, Erckmann-Chatrian. The younger Dumas, Victorien Sardou, Octave Feuillet, Ernest Feydeau, Henri Murger, Gustave Flaubert, developed a realistic style of novel in which social problems are treated with more candour than delicacy. During the second half of the nineteenth century a school of writers arose who strove to outdo the most realistic of their predecessors. The chiefs of this school were Émile Zola, Guy de Maupassant, Émile Gaboriau, Victor Cherbuliez, Alphonse Daudet, &c.

In works of history the eighteenth and nineteenth centuries were very prolific, the leading historians being Michaud (1767-1839), Sismondi (1773-1842), Guizot (1787-1874), Amédée Thierry (1787-1873), Augustin Thierry (1795-1856), Mignet (1796-1884), Thiers (1797-1877), Michelet (1798-1874), Henri Martin (1810-83), Victor Duruy (1811-94), Louis Blanc (1813-82). Literary historians are: Villemain (1790-1870), Vinet (1797-1847), J. J. Ampère (1800-64), Littré (1801-81), St. Marc-Girardin (1801-73), Sainte-Beuve (1804-69), Taine (1828-93), Demogot, Fustel de Coulanges, Lavisse, and Sorel. Philosophy is represented by Lamennais (1782-1854), Victor Cousin (1792-1867), Jouffroy (1796-1842), Rémusat (1797-1875), Auguste Comte (1798-1857), Quinet (1803-75), Montalembert (1810-70), Renan (1823-92), and in the twentieth century Fouillée, Bergson, and Boutroux. Among the writers on political economy and sociology are Bastiat (1801-50), Tocqueville (1805-59), Chevalier (1806-79), Proudhon (1809-65), Jules Simon (1814-96), Prévost-Paradol (1829-70), Letourneau, and Dürkheim. Among scientific writers are Étienne Geoffroy St. Hilaire and his son Isidore, Cuvier, Jussieu, Duméril, in natural science; Gay-Lussac, Bichat, Corvisart, Magendie, Berthelot, and Le Chatelier in chemistry and medicine; and Lagrange, Laplace, Arago, and H. Poincaré in mathematics. Amongst Orientalists of note are Champollion, Burnouf, Silvestre de Sacy, Stanislas Julien, Sylvain Lévi, Maspero, Opert, &c. The essayists and literary and art critics are legion. We can only mention by name Théophile Gautier, Jules Janin, Philarrète Chasles, Léon Gozlan, Paul de St. Victor, Gustave Planche, and St. René Taillandier.

Among more modern critics are Brunetière, Doumic, Fagniet, Larroumet, and Lanson. Amongst poets who belong to a date posterior to the Romantic movement, or show different tendencies, may be mentioned Gautier, who inaugurated the Parnassian school of poetry and formulated the doctrine *l'art pour l'art*, and his disciples Banville and Baudelaire. Others were: Leconte de Lisle, François Coppée, Sully Prudhomme, Catulle Mendès, the modern Provençal poets, Frédéric Mistral and Théodore Aubanel. Paul Verlaine and Mallarmé, on the other hand, founded the Symbolist school of poetry. Symbolism, it may be pointed out, is individualism carried to its extreme. To the Symbolists belong the Belgians Mactierlinck, Verhaeren, and Rodenbach. Among well-known contemporary novelists are: Bourget, Bazin, Bordeaux, Barbusse, Anatole France, Pierre Loti, Marcel Prévost, Pierre Benoît, &c. Among dramatists we may mention: Brieux, Donnay, Henri Bataille, Henri Bernstein, and last, but not least, Edmond Rostand, poet and dramatist.—BIBLIOGRAPHY: Petit de Julleville, *Histoire de la langue et de la littérature française des origines à 1900*; Nisard, *Histoire de la littérature française*; F. Brunetière, *Manual of the History of French Literature*; G. E. B. Saintsbury, *A Short History of French Literature*; E. Dowden, *A History of French Literature*; Kastner and Atkins, *A Short History of French Literature*; L. Claretie, *Histoire de la littérature française, les contemporains, 1900-1910*.

France, Anatole, assumed name of *Jacques Anatole Thibault*, French author, born in Paris 16th April, 1844. The son of a bookseller, he was brought up in a literary atmosphere, and educated at the Collège Stanislas, Paris. Devoting himself to literature, he made his entry into the world of letters in 1868 with his study on *Alfred de Vigny*. This essay was followed by many editorial prefaces to the works of French classics, by his *Poèmes dorés*, *Les Noces Corinthiennes*, and *Le Chat maigre*. He first attracted attention, however, in 1882, with his *Le Crime de Sylvestre Bonnard*, which was crowned by the Academy. This work placed the young author in the first rank of French novelists, and since then his success has continued. He was elected to the Académie Française in 1896, and was made an officer of the Legion of Honour. Anatole France is not only a novelist, but at once a satirist and a critic, a philosopher and a theologian, a historian and a politician. His novels, simple and plotless, are veritable storehouses of a vast amount of erudition which the author has accumulated. As an Agnostic France is particularly interested in religious feelings and situations. A spiritual descendant of Renan, he is an implacable master of irony, but he has also affinities with Aristophanes and Epicurus, Voltaire and Heine.

A sceptic, he has also the gift of pity, and whilst he criticizes, he also seeks to understand human stupidity and human failings, and "tout comprendre, c'est tout pardonner". A perfect stylist and a prince of humorists, France stands alone, in his ideas as well as in his style, and can scarcely be compared with any other contemporary French author. He shocks ordinary morality, ordinary faith and conduct, and condemns conventional practices in matters of right and justice. Even those who dislike France's philosophy, however, are compelled to admire the artist in him. A fighter for freedom and justice, he was always ready to protest against the crimes of nations and governments, and to employ his pen and his eloquence in the service of the oppressed. He showed this attitude more than once, as during the Dreyfus affair, when he supported Zola, in the Armenian massacres, and the Russian pogroms. And yet, in spite of his radicalism, France is not a democrat; he is an aristocrat to the core, an aristocrat à la Renan and Flaubert, the fore-runners and inspirers of Nietzsche. It is this spirit of aristocracy which makes France's works breathe a spirit of hatred against the existing social order. His books are at once novels and works of criticism, revealing an author who is both a charming story-teller and a subtly reasoning philosopher. They are not only tales of romance and adventure, but essays on art, religion, and philosophy, full of original sayings and discussions on history and morality. Among his numerous works, the majority of which have appeared in English, are: *Le Livre de mon ami* (1885), *Thaïs* (1890), *La Rôtisserie de la Reine Pédauque* (1893), *M. Bergeret à Paris* (1901), *Crainquebille* (1902), *Histoire de Jeanne d'Arc* (1908), *L'Île des Pingouins* (1908), *Les Dieux ont Soif* (1912), *La Révolte des Anges* (1914), &c. He died in 1924. — BIBLIOGRAPHY: G. Brandes, *Anatole France*; W. L. George, *Anatole France*; J. Huneker, *Egoists*; A. S. Rappoport, *The Anatole France Calendar*.

France, Isle of (*Île-de-France*), an ancient province of France, so called because it was originally bounded by the Seine, Marne, Oureq, Aisne, and Oise, and formed almost an island.

Francesca da Rimini (frân-ches'kâ dà rê-minî), an Italian lady, daughter of Guido da Polenta, Lord of Ravenna, lived in the latter part of the thirteenth century. She was married to Lanciotto, or Sciancato, the deformed son of the Lord of Rimini, who, discovering an intimacy between her and his brother Paolo, put them both to death. The story forms an episode in Dante's *Inferno*, and is alluded to by Petrarch; it is the subject of a poem by Leigh Hunt, of a tragedy by Silvio Pellico, a dramatic poem by Stephen Phillips, and a drama by D'Annunzio. There is

also an opera *Françoise da Rimini*, by Ambroise Thomas, and a symphonic poem by Tchaikovsky. Pictures of Paolo and Francesca have been produced by Ingres (in the Chantilly Museum), Cabanel (in the Luxembourg), and Ary Scheffer (in the Wallace Collection).—Cf. Yriarte, *Françoise da Rimini dans la légende et dans l'histoire*.

Francesco di Paula. See *Francis of Paula*.

Franche-Comté (frânsh-kon-tâ), an ancient province of France, forming at present the departments of Doubs, Haute-Saône, and Jura. It formed part of the Kingdom of Burgundy.

Franchet d'Esperey, Louis, French soldier, born at Mostaganem, Algeria, in 1856. Entering the army in 1876, he saw service in Tunis, Tongking, China, and Morocco, and commanded the French Fifth Army in Aug., 1914. In 1918 he became supreme commander of the Allied armies in the Orient, and obtained the surrender of Bulgaria. Until 1920 he commanded the Allied armies in European Turkey. He was created Marshal in Feb., 1921.

Franchise (fran'chîz), in a general and legal sense, a particular privilege or right granted by a prince, sovereign, or Government to an individual, or to a number of persons. In politics, in regard to which the term is most commonly used, it is the right of voting upon proposed legislative measures, where such measures are accepted or rejected by the people generally; or for representatives to a legislative assembly (the parliamentary franchise) or to a municipal body.

Francia, Francesco. See *Raiabolini*.

Francia, Dr. José Gaspar Rodríguez, Dictator of Paraguay, born about 1758, died 1840. He was for some time a theological professor, and afterwards gained distinction as an advocate at Asuncion. In 1811, when Paraguay threw off the Spanish yoke, he became secretary of the Junta appointed by Congress. In 1814 he was appointed Dictator for three years, and in 1817 he was continued in authority for life. He did much to consolidate the new republic; but his rule was arbitrary in the extreme. In spite of his cruelty and rigour he was generally beloved by his subjects.

Francis I, King of France, was born 1494, died 1547. His father was Charles of Orleans, Count of Angoulême, and his mother Louise of Savoy, grand-daughter of Valentine, Duke of Milan. He ascended the throne in 1515, having succeeded his uncle, Louis XII. In prosecution of his claim to Milan he defeated the Swiss in the plains of Marignano, and forced the reigning duke, Maximilian Sforza, to relinquish the sovereignty. On the death of Maximilian (1519) Francis was one of the competitors for the empire; but the choice fell on Charles of Austria, the grandson of Maximilian, henceforth known as the Emperor Charles V. From this period

Francis and Charles were rivals, and were almost continually at war with one another. Both attempted to gain the alliance of England. With this view Francis invited Henry VIII of England to an interview, which took place near Calais, between Guînes and Ardres, in June, 1520. The magnificence of the two monarchs and their suites on this occasion has given to the meeting the name of the Field of the Cloth of Gold. In 1521 war broke out between the rivals, and in 1525 Francis was defeated and taken prisoner at Pavia. He could recover his liberty only by renouncing his claims to Naples, Milan, Genoa, and Asti, the suzerainty of Flanders and Artois, and promising to cede the Duchy of Burgundy and some other French fiefs. War was soon after renewed, an alliance, called the Holy League, having been formed between the Pope Clement VII, the King of France, the King of England, the Republic of Venice, the Duke of Milan, and other Italian powers, with the object of checking the advances of the emperor. In this war Rome was taken and sacked by the Constable of Bourbon (1527), and Italy was devastated, but Francis gained little either of fame or material advantage. Peace was concluded in 1529, but hostilities again broke out in 1535, when Francis possessed himself of Savoy. A hastily-made-up peace was soon broken, and Francis again found himself at war with the emperor and the King of England. Fortunately for France the union of the Protestant princes of Germany against the emperor prevented him from following up his success, and inclined him to a peace, which was concluded at Crespy in 1544. Charles resigned all his claims to Burgundy, and allowed Francis to retain Savoy. Two years after, peace was made with England. Francis I possessed a chivalric and enterprising spirit, and was a patron of learning. —BIBLIOGRAPHY: Capefigue, *François I et la Renaissance*; Julia Pardoe, *The Court and Reign of François I*; A. C. P. Haggard, *Two Great Rivals, François I and Charles V*.

Francis II, King of France, son of Henry II and Catherine de' Medici, born at Fontainebleau in 1544, ascended the throne on the death of his father, 1559. The year previous he had married Mary Stuart, only child of James V, King of Scotland. The uncles of his wife, Francis, Duke of Guise, and the Cardinal of Lorraine, held the reins of government. Francis, who was of a feeble constitution, died in Dec., 1560.

Francis I, Emperor of Germany, eldest son of Leopold, Duke of Lorraine, was born in 1708. In 1736 he married Maria Theresa, daughter of the Emperor Charles VI. After the death of Charles VI (1740), he was declared by his wife co-regent of all the hereditary states of Austria, but without being permitted to take any part

in the administration. After the death of Charles VII, he was elected emperor in 1745. He died in 1765. See *Maria Theresa*.

Francis I, Emperor of Austria (previously Francis II, Holy Roman Emperor), was born 1768, died 1835. He was the son of the Emperor Leopold II and Maria Louisa, daughter of Charles III, King of Spain. He succeeded his father in 1792. France declared war against him in 1792, and hostilities continued till the Peace of Campo-Formio, 1797. In 1799 he entered into a new coalition with England and Russia against the French Republic; but in 1801 Russia and Austria were compelled to conclude the Peace of Lunéville. France having been declared an empire in 1804, he assumed the title of *hereditary Emperor of Austria*; and on the establishment of the Confederacy of the Rhine in 1806, he renounced the title of Emperor of Germany. In 1805 war again broke out between Austria and France. But after the battle of Austerlitz (1805) the Peace of Presburg was signed. In 1809 he again took up arms against France, and in the Peace of Vienna was compelled to surrender 42,000 sq. miles of territory. The marriage of his daughter, Maria Louisa, with Napoleon promised to form a strong tie between the imperial Houses, but in 1813 he entered into an alliance with Russia and Prussia against France, and was present to the close of the contest.

Francis of Assisi, St., founder of the Order of the Franciscans, was born at Assisi, in Umbria, in 1182, where he died in 1226. In youth Francis did not refrain from the pleasures of the world; but after a serious illness he became enthusiastically devout, left the paternal roof, and in 1208 gave himself to a life of the most rigorous poverty. His followers were at first few, but when they reached the number of eleven he formed them into a new order, made a rule for them, and got it sanctioned, though at first only verbally, in 1210, by Pope Innocent III. In 1212 he received from the Benedictines a church in the vicinity of Assisi, which now became the home of the order of the Franciscans or Minorites. Francis afterwards obtained a bull in confirmation of his order, from Pope Honorius III. After an unsuccessful attempt to convert the Sultan Meledin, he returned to Assisi, when the order of St. Clara was founded under his direction, and a third order, called the Tertiaries, designed for penitents of both sexes. He was canonized by Pope Gregory IX in 1228. His festival is on the 4th of Oct. See *Franciscans*. —BIBLIOGRAPHY: Paul Sabatier, *Vie de St. François* (English translation by L. S. Houghton); A. Barine, *St. François d'Assise et la légende de ses trois compagnons*; Canon Knox-Little, *St. Francis of Assisi*; Stoddart, *Francis of Assisi*; Duff Gordon, *The Story of Assisi*; Father Cuthbert,

Life of St. Francis of Assisi; J. Jørgensen, *St. Francis of Assisi: a Biography*.

Francis of Paola, or **Paula**, **St.**, was born in 1416 in the city of Paula, in Calabria, died in France 1507. He was brought up in a Franciscan convent, and in 1436 founded a new order, which, when the statutes were confirmed by Alexander VI, received the name of the *Minims* (Lat. *minimi*, the least). To the three usual vows Francis added a fourth, that of keeping the Lenten fast during the whole year. The fame of his miraculous cures reached Louis XI of France, who invited him to France in the hope that Francis would be able to prolong his life. After the death of Louis, Charles VIII built him a monastery in the park of Plessis-les-Tours and also at Amboise, and loaded him with honour and tokens of veneration. Twelve years after his death he was canonized by Leo X, and his festival is on the 2nd of April. See *Minims*.

Francis of Sales. See *Sales*.

Francis Ferdinand, Archduke of Austria, born in 1863, assassinated at Serajevo in 1914. A nephew of the Emperor Francis Joseph and the son of Archduke Charles Louis, he became heir-presumptive to the crown of the Dual Monarchy after the death of Prince Rudolf of Austria in 1889. In 1900 he marriedmorganatically the Countess Sophia Chotek, who was created Princess of Hohenberg. The archduke then renounced for his future children the right of succession to the thrones of Austria and Hungary. It was during his tour in Bosnia that he was assassinated at Serajevo on 28th June, 1914, an event which precipitated the European War.

Francis Joseph I, Emperor of Austria and King of Hungary, born at Vienna 18th Aug., 1830, died at Schönbrunn 21st Nov., 1916. Revolts had forced his uncle, Ferdinand I, to abdicate, and when his father, Francis Charles, renounced his rights, Francis Joseph succeeded to the throne of the Dual Monarchy in 1848. His reign thus lasted sixty-eight years, exceeding that of Queen Victoria. Francis Joseph was during his long reign above everything a Habsburg, and nearly all his acts were dictated by the interests of his House. Thus he not only refrained from establishing the Constitution which he had promised to his subjects in 1849, but refused to recognize the Constitution granted by his predecessor to Hungary. Nicholas I of Russia helped him to quell the Separatist movement in Hungary, whilst his general Radetzki brutally suppressed the attempt of the Lombardians to shake off the Austrian yoke. In 1854 he married Elizabeth, daughter of Duke Max of Bavaria. During his long reign Francis Joseph not only saw the prestige of his House diminished, and Austria losing many of her possessions, but he also lived through a series

of family tragedies. His only son, Prince Rudolf, met a violent death at Meyerling; his wife was assassinated at Geneva in 1897; his sister-in-law, the wife of Emperor Maximilian of Mexico, went mad after her husband's death. The climax came when, in June, 1914, the Archduke Francis Ferdinand, nephew of the emperor and heir to the throne, was murdered with his wife at Serajevo in Bosnia. The crime of Serajevo and the Austrian ultimatum to Serbia precipitated the crisis and led to the European War, which, in spite of the promise of politicians and litterateurs that it would be "the war which will end war", has, unfortunately, sown the germs of future conflicts. The emperor's reign was a long one, but his life was full of public calamity and private distress and unhappiness. He had always insisted on supervising foreign affairs, but his decisions were never crowned with success. Nearly always his diplomacy resulted in national humiliation. And yet he remained until his death very popular among his subjects, and it was due to his popularity that his empire did not fall to pieces during his lifetime. Francis Joseph was to a great extent personally responsible for the European War, but he did not live to see the end and the downfall of the House of Habsburg. See *Austria*; *European War*.—**BIBLIOGRAPHY**: R. P. Mahaffy, *Francis Joseph: his Life and his Times*; H. de Weindt, *The Real Francis Joseph*; F. Gribble, *Life of the Emperor of Austria*.

Francis, Philip, poet and dramatist, was born in Dublin 1700, died 1773. Educated at Dublin, he took orders, and kept an academy at Esher, Surrey, where Gibbon was one of his pupils. He was afterwards chaplain to Chelsea Hospital. He is best known from his translations of Horace and other classic authors.

Francis, Sir Philip, one of the many political writers to whom the authorship of the *Letters of Junius* has been ascribed, was the son of the preceding, born in Ireland in 1740, died 1818. In 1773 he went to the East Indies, where he became a member of the Council of Bengal, and the constant opponent of Warren Hastings. In 1781 Francis returned to England, and shortly after was chosen member of Parliament for the borough of Yarmouth in the Isle of Wight. He took a prominent part in the impeachment of Hastings. He published several political pamphlets. Francis is generally considered to have been the author of the *Letters of Junius*. The majority of competent critics hold this opinion, which is supported by stronger evidence than the claims of other authors. The whole matter is still far from being decided. See *Junius*.—**Cf.** article in *Dictionary of National Biography*.

Franciscans, the members of the religious order established by St. Francis of Assisi about

1210. They are also called Minorites, or *Fratres Minores* ('lesser friars'), which was the name given them by their founder in token of humility, and sometimes Grey Friars, from the colour of their garment. The order was distinguished by vows of absolute poverty and a renunciation of the pleasures of the world, and was intended to serve the Church by its care of the religious state of the people. The rule of the order destined them to beg and to preach. The Popes granted them extensive privileges, and they had an evil repute as spies, frequenting the courts of princes



Franciscans—with and without cloak

and the houses of noblemen, gentry, &c. They appeared in Great Britain in 1220. Early in the fifteenth century the Franciscans split up into two branches, the Conventuals and the Observants or Sabotiers. The former went barefooted, wore a long grey cassock and cloak and hood of large dimensions, covering the breast and back, and a knotted girdle. The Observants wore wooden sandals, a cassock, a narrow hood, a short cloak with a wooden clasp, and a brown robe. In France the members of the order not belonging to any particular sect are called Cordeliers, from the cord which they tie about them. The Capuchins, so called from the peculiar kind of hood or cowl (*capuce*) which they wear, originated in a reform introduced among the Observantists by Matteo di Bassi in the early part of the sixteenth century. Although it received the approbation of different Popes within a short

time after its foundation, it did not receive the right of electing a particular general and become an independent order till 1610.

St. Francis himself collected nuns in 1209. St. Clara was their prioress; hence they were called the *nuns of St. Clara*. The nuns were also divided into branches, according to the severity of their rules. The Urbanists were a branch founded by Pope Urban IV; they revered St. Isabelle, daughter of Louis VIII of France, as their mother. St. Francis also founded in 1221 a third order, of both sexes, for persons who did not wish to take the monastic vows, and yet desired to adopt a few of the easier observances. They are called Tertiarians or Tertiaries, and were very numerous in the thirteenth century. From them proceeded several heretical fraternities, as the Fraticelli and Beghards. The whole number of Franciscans and Capuchins in the eighteenth century amounted to 115,000 monks, in 7000 convents. At the dissolution of the monasteries in England there were sixty-five houses of the Franciscans. The order has given five Popes and more than fifty cardinals to the Church. There are now several houses in Great Britain and Ireland. Friar Roger Bacon, Duns Scotus, St. Bonaventure, Alexander of Hales, and William of Ockham were Franciscans.—BIBLIOGRAPHY: L. Wadding, *Annales Minorum Fratrum*; Brewer, *Monumenta Franciscana*; Cusack, *St. Francis and the Franciscans*; A. G. Little, *The Grey Friars in Oxford*; J. Sever, *The English Franciscans under Henry VIII*.

Francis Xavier, St. See Xavier.

Francke (frän'ké), August Hermann, German theologian and philanthropist, born at Lübeck 1663, died at Halle 1727. He was professor of Oriental literature and then of theology at Halle, but is chiefly known for his successful labours on behalf of poor orphans. In 1695 he founded the famous orphanage at Halle, still known by his name, which now includes, besides the orphan asylum, a great variety of schools, a printing and publishing establishment, chemical laboratory, &c. His *Manuductio* (1693) was translated into English under the title of *A Guide to the Reading and Study of the Holy Scriptures* (1813).

Franco-German War of 1870-1. The immediate occasion of this war was an offer made in June, 1870, by General Prim, then at the head of affairs in Spain, of the crown of that country to Leopold of Hohenzollern, a prince belonging to the reigning house of Prussia. The Government of Napoleon III demanded of the King of Prussia that he should forbid the candidature of the prince. Though the prince voluntarily withdrew it, the French Ambassador, Benedetti, demanded from King William at Ems a guarantee against any renewal of the candidature. A telegram from the king giving an account of

this interview was published by Bismarck with certain omissions, and the state of public feeling in France was such that war was declared on Prussia on the 19th of July. The French were the first in getting their troops to the frontier; but it soon became manifest that instead of being in a complete state of readiness for war, as the Minister of War had declared, the French army was defective in almost everything essential to the equipment of an army.

In Germany everything formed a complete contrast to this state of matters. Each section of the army was completely organized in the head-quarters of the district which it occupied in time of peace, and was sent to the frontiers only after being furnished with everything it required. In addition to this, Prussia, against which country alone the war had been declared, was not only joined, according to treaty, by all the states of the North German Confederation, but also by those of the South, upon whose neutrality, perhaps even upon whose alliance, Napoleon and the French had counted.

The German forces were divided about the end of July into three armies, one of which, known as the First Army, had its head-quarters at Trèves under General Steinmetz; another of which, known as the Second Army, occupied the Bavarian Palatinate under Prince Frederick Charles; while the Third Army, under the Crown Prince of Prussia, was stationed in Northern Baden. The commander-in-chief of the whole forces was King William of Prussia, who was supported by a staff of general officers, with von Moltke at their head. The French army, under Napoleon himself, had its head-quarters at Metz, and two advanced divisions were stationed on the borders of France and Germany, the one in the north on the Saar, under General Frossard, the other farther south at Weissenburg, under General Douay. The victories of the Third Army, under the Crown Prince, at Weissenburg (4th Aug.) and at Wörth (6th Aug.), and of the First and Second Armies at Forbach (6th Aug.), put the French army in retreat along its whole line, the southern half in the direction of Nancy, and the northern of Metz. The northern army, under Bazaine, was overtaken by those of Steinmetz and Frederick Charles on the 14th of Aug., when an engagement at Courcelles took place, in which the Germans were again victorious. This was followed by the battles of Vionville, or Mars-la-Tour, and Gravelotte, the result being that Bazaine withdrew his army under the protection of the fortifications of Metz, which was now surrounded by an army under the command of Prince Frederick Charles.

Meantime the Crown Prince of Prussia had advanced as far as Nancy, and was there awaiting the result of the battles around Metz. He

had still the army of MacMahon to deal with, which had now reached Châlons, where it had been reorganized and strengthened to such a degree that the army of the Crown Prince was no longer able to cope with it unaided. Accordingly, out of three *corps d'armée* belonging to the Second Army, a new army was formed, which was afterwards called the Army of the Meuse, and was placed under the Crown Prince of Saxony. About the 20th of Aug. these two armies set out on parallel routes in the direction of Châlons in order to engage the army of MacMahon, which it was expected would now retreat on Paris. Instead of this, however, Count Palikao, Minister of War at Paris, issued an order to Marshal MacMahon to strike northwards to the Belgian frontier that he might thence make a descent upon Metz and relieve Bazaine. On the 27th of Aug., at Buzancy, an advanced detachment of cavalry belonging to the Army of the Meuse dispersed a body of French Chasseurs, and on the days immediately succeeding a number of engagements and strategic movements ensued, the result of which was that on the 1st of Sept. the army of MacMahon was surrounded at Sedan by a force of overwhelmingly greater numbers, and on the following day both army and fortress surrendered by capitulation. On this occasion 50 generals, 5000 other officers, and 84,000 private soldiers became prisoners of war. Among these was Napoleon III. who was unexpectedly found to have been present with the army of MacMahon. He had a personal interview on the day after the battle with King William of Prussia, who assigned to him Wilhelmshöhe, near Cassel, as his place of residence during his captivity.

One of the first consequences of this defeat was an outburst of rage on the part of the Parisians against the Napoleon dynasty. On the 4th of Sept. the Third Republic was proclaimed by Gambetta, Jules Favre, Crémieux, Ferry, and Jules Simon, members of the Corps Législatif, and the emperor was declared dethroned. A Government of National Defence was formed, at the head of which was placed General Trochu, military governor of Paris. Meantime France had no available army which was strong enough to stand its ground for an instant before the German armies that were now enabled to continue their march upon Paris. The investment of the city was completed on the 19th of Sept. It was not till about the beginning of October that the French were able to organize a new army after the loss of that of MacMahon, and by the beginning of November the war in the open field had been resumed in different centres; but the capitulation of Metz with the army of Bazaine (28th Oct.), and that of Strasbourg (27th Sept.), had set free for further operations large

numbers of German troops, and the utmost efforts of the French could not relieve Paris.

The city had held out for a much longer period than even the most sanguine on the side of the French had at first expected that it would be able to do. Sallics were made at intervals by the garrison (12th, 21st of Oct., 13th, 14th, 15th, and 19th of Jan.), but not sufficiently often or in sufficient strength to have any decisive effect. On the failure of the last sally, which took place on the west side from Mont Valérien on the 19th of Jan., it was seen that a capitulation was inevitable. On 21st Feb. M. Thiers, Head of the Executive, arrived at Versailles along with a diplomatic commission, and preliminaries of peace were signed at Versailles on the 26th of Feb., and accepted by the National Assembly at Bordeaux on the 1st of March, by a vote of 546 to 107. Among those who voted against the preliminaries of peace was Clemenceau. The principal terms were the following: (1) That France should cede to Germany one-fifth part of Lorraine, including Metz, together with the whole of Alsace except Belfort and the surrounding district. (2) That France should pay to Germany a war indemnity of five milliards of francs (£200,000,000). (3) That certain departments of France should remain in the occupation of the Germans, and should not be fully evacuated until after the payment of the whole indemnity. The definitive treaty of peace, which was signed at Frankfort on the 10th of May, 1871, and ratified on the 21st, confirmed in all essential particulars the preliminaries of Versailles. The last instalment of the war indemnity was paid on the 5th of Sept., 1873, and France completely evacuated by the Germans on the 13th of the same month.—BIBLIOGRAPHY: Von Moltke, *The Franco-German War 1870-71*; Chuquet, *La guerre de 1870-71*; *The Franco-German War* (in Cambridge Modern History); Major-General J. F. Maurice (editor and translator), *The Franco-German War, 1870-71*.

Fran'colin, a genus of birds belonging to the same family as the partridge, which they resemble in many respects, though they usually have one or more strong and sharp horny spurs on the tarsi. The only European member of the genus is the *Franco'linus vulgâris*, which is characterized by a red band round the neck, and red feet. It is found in the south of France, Sicily, Cyprus, and the southern part of Europe generally. It also ranges east to North India, where it is known as the 'black partridge'. The other species belong to Africa, Asia, and Oceania. The 'redwing' (*F. levaillanti*) of Cape Province is familiar to sportsmen.

Franco'nia (in Ger. *Franken*, so called because early in the sixth century it was colonized by Franks), a district of Germany lying to the

east of the Rhine, and traversed by the Main. After the dismemberment of the Carolingian Empire, this district became attached to the German division, and ultimately formed one of the grand duchies of Germany. In 1806 it was partitioned among Württemberg, Baden, Hesse-Cassel, the Saxon duchies, and Bavaria. The last received the largest share, now forming the three divisions of Upper, Middle, and Lower Franconia.

Franc-tireur (fran-tê-reur), literally a free shooter: an irregular sharp-shooter, one of a body of soldiers organized in France in the Franco-German War, and employed in guerrilla warfare for harassing the enemy and cutting off detachments. On the 22nd Jan., 1871, the franc-tireurs blew up the Moselle railway bridge at Fontenoy.

Fran'eker, a town in Holland, in the province of Friesland, on a canal communicating with the sea at Harlingen. It was long celebrated as a school of theology. Pop. 7642.

Frangipani (fran-ji-pä'nē), the name of an illustrious Roman family whose history dates from A.D. 1014. The name is said to have been derived from the generosity of the family, who distributed bread during a famine in Rome.—*Frangipani* is also the name of a perfume invented by the Marquis Frangipani, Maréchal des Armées of Louis XIII of France. It was a powder composed of every spice then known, with the addition of ground orris-root and musk. It is now a perfume prepared from, or imitating the odour of, the flower of a West Indian tree, *Plumiera rubra*, or red jasmine.

Fran'gulin, a yellow crystallizable colouring matter contained in the bark of the berry-bearing alder (*Rhamnus Frangula*). It is a bright-yellow, silky, crystalline mass, without taste or smell, which fuses on heating, and can be sublimed in golden needles. It dyes silk, wool, and cotton.

Frank, the signature of a person possessing the privilege of sending letters free of postage. In Britain the privilege of giving franks for letters was enjoyed within certain limits by all peers, members of Parliament, &c., till 1840, when it was abolished by the Act which established the penny postage.

Frank'almoigne (-moin), literally 'free alms', an English mode of tenure according to which a religious corporation held lands without being required to perform any but religious services, such as praying for the souls of the donors. This is the tenure by which almost all the ancient monasteries and religious houses held their lands, and by which the parochial clergy and very many ecclesiastical and eleemosynary foundations hold them to this day, the nature of the service being, upon the Reformation, altered and made conformable to the Reformed Church.

Frankenberg, a German town, in Saxony, 40 miles s.e. of Leipzig. It is regularly built, and has extensive manufactures of woollens, cottons, and silks. Pop. 13,576.

Frankenhausen, a town of Germany, in the former principality of Schwarzburg-Rudolstadt, one of the Thuringian states, on an artificial arm of the River Wipper, 33 miles n.n.e. of Gotha. It has important rock-salt mines and salt-springs, also lignite and sandstone quarries. It was the scene of the defeat of Thomas Münzer and the Anabaptists in the Peasants' War in 1525. Pop. 6600.

Frankenstein, the student hero of a tale by Mrs. Shelley. He constructed a monster from human fragments gathered in burial-grounds and dissecting-rooms, and by galvanism succeeded in enduing it with life, though not with soul. Powerful for evil, it wrought a dreadful retribution upon its maker, who had usurped the prerogative of the Creator. References to this monster under the name of its maker, Frankenstein, are popular in metaphor.

Frankenstein, a town in Prussia, province of Silesia, 36 miles s.s.w. of Breslau. It has manufactures of cloth, and gunpowder and other mills. Pop. 7960.

Frankenthal (-täl), a town in Bavaria, in the Palatinate, on a canal near the Rhine, 33 miles s.s.e. of Mainz. It has varied manufactures. Pop. 17,100.

Frankfort, the capital of Kentucky, United States, picturesquely situated on the Kentucky River, 25 miles w.n.w. of Lexington. It has a fine marble State house (capitol), an arsenal, saw-mills, shoe and furniture factories, &c. Pop. 10,465.—Another town of this name, in Indiana, 40 miles north-west of Indianapolis, is a railway centre. Pop. 9805.

Frankfort-on-the-Main (Ger. *Frankfurt am Main*), a town of Prussia, in the province of Hesse-Nassau, 20 miles n.e. of Mayence (Mainz). It was formerly a free town of the empire, and down to 1866 one of the free towns of the German Confederation and the seat of the Diet. It is mainly situated on the right bank of the Main, but has the suburb of Sachsenhausen on the left bank, the river being crossed by seven bridges (two for railways). Both banks of the river are lined by spacious quays. The older part of the town contains a number of ancient houses, and largely consists of narrow and unattractive streets, but the principal street, the Zeil, and those of the newer parts of the town, are spacious and have many handsome modern buildings. The older portion is surrounded by the *Anlagen* or promenades with gardens, on the site of the old fortifications. Fronting these promenades and in the districts outside of them are very many handsome, and some palatial, private resi-

dences with gardens. The Römerberg and the Ross-markt (horse-market) are the chief squares in the town. The Römer or town house was erected about 1405, but has been greatly altered since, and modern structures have been added. In one of its halls the Electors of the empire met and made arrangements for electing the emperor, and in it the magistrates now sit. In another, the Kaisersaal, the emperor was banqueted after election, and waited on by kings and princes. The most remarkable of the churches is the Dom or Cathedral of St. Bartholomew (Roman Catholic), in which the German emperors after 1711 were crowned. It is a Gothic edifice, begun in 1238. The choir was built between 1315 and 1318. The building was seriously injured by fire in 1867, but has been completely restored, the tower left incomplete since 1514 being finished in accordance with the original plans. Other buildings are the new opera-house, one of the finest buildings of the kind; the courts of justice, of modern construction; the new exchange, a spacious and handsome edifice; the large palace of the Prince of Thurn and Taxis; the new railway station, a very fine building, which can be favourably compared with any similar structure; the archive building, post office, the house in which Luther dwelt, and that in which Goethe was born and lived till 1775. There are monuments to Gutenberg, Goethe, Schiller, and others. Frankfort is rich in collections connected with literature and art, and in establishments intended to promote them. The chief of these are the Historical Museum (in the archive building), the Städel Art Institute (in Sachsenhausen), containing a fine gallery of pictures and other collections; the Senckenberg Museum of Natural History; the town library, possessing over 300,000 printed volumes. There is also a zoological garden and the Palm Garden, both favourite places of resort. The manufactures comprise chemicals, ornamental articles of metal, sewing-machines, straw hats, soap, perfumery, and beer. A great business is done in money and banking. The town is provided with tramways, is a great railway centre, and is now reached by the largest vessels navigating the Rhine. Frankfort dates from the time of Charlemagne. It was made an imperial free city by a decree of the Emperor Louis V in 1329. Frederick Barbarossa had been elected emperor here in 1152, and in 1356 the right of being the place of election for all future emperors was granted to it by the Golden Bull. Frankfort suffered severely in the Schmalkald War (1552), the Thirty Years' War (1635), the Seven Years' War (1702), and during the French Wars (1792, 1796, 1799, 1800, 1806). Under Napoleon it became the capital, first of a principality, and then, in 1806, of a grand duchy. From 1814

to 1866 it was one of the four free cities of the German Confederation, and in 1866 it was taken by the Prussians. The town was occupied by French troops on the 6th of April, 1920, pending the withdrawal of German troops from the Ruhr district. It was evacuated on 17th May, 1920. Pop. 433,022 (60 per cent being Protestants).

Frankfort-on-the-Oder (*Frankfurt an der Oder*), a town of Prussia, province of Brandenburg, on the Oder, 52 miles E.S.E. of Berlin. It is built with considerable regularity, and was an important military centre until 1918. Many retired officers and Government officials take up their residence here. The manufactures consist of machinery and metal goods, chemicals, leather, earthenware, and spirits; and the trade is extensive both by land and water. Frankfort was annexed to Brandenburg in 1250, and notwithstanding its repeated captures during the Hussite, the Thirty Years', and the Seven Years' War, was always an important commercial place. Pop. 65,055.

Frank'incense, a name given to the oleo-resinous exudations from different species of conifers. American frankincense is got as a soft, yellow, resinous solid, with a characteristic turpentine odour, from *Pinus Taeda*. Another kind is exuded by the spruce fir, and forms a soft solid, the colour of which varies from white to violet-red. From this Burgundy pitch is prepared by melting in water and straining through a cloth. The frankincense employed in religious ceremonies (called also *incense* and *olibanum*) is a gum-resin obtained from *Boswellia thurifera* (or *serrata*), a tree somewhat resembling the sumach, belonging to the Amyridaceae, and growing amongst the mountains of India. It comes to us in semi-transparent yellowish tears, or sometimes in masses, of specific gravity 1.22; it possesses a bitter and nauseous taste, and is capable of being pulverized. When burned, it exhales a strong aromatic odour, on which account it was much employed in the ancient temples, and still continues to be used in Catholic churches.

Frankland, Sir Edward, English chemist and authority on sanitation, was born in 1825 at Churchtown, in Lancashire, died in Norway in 1899. He served an apprenticeship to a chemist in Lancaster, afterwards studying in London under Playfair, and at Marburg and Giessen under Bunsen and Liebig respectively. In 1851 he became professor at the newly founded Owens College in Manchester, and in 1852 suggested the conception of the valency of organic compounds. In 1853 he was elected F.R.S., and in 1857 received the society's gold medal. From 1863 to 1868 he was professor of chemistry in the Royal Institution, and held a similar post in the Royal School of Mines (afterwards merged

in the Royal College of Science) from 1865 to 1885. For many years he was Government water-analyst, and in 1868 was appointed a member of the second Royal Commission on river-pollution. He was a member of various foreign scientific academies, and was made K.C.B. in 1897. He and Sir Norman Lockyer were the original discoverers of helium (in 1868). In 1877 he published a volume of *Experimental Researches in Pure, Applied, and Physical Chemistry*, a work on *Inorganic Chemistry* (with F. R. Japp, 1884), besides many other works and papers.

Franklin, formerly the designation for a freeholder, yeoman, or landowner, holding directly from the Crown, and not of noble birth.

Franklin, Benjamin, American writer and politician, born at Boston 17th Jan., 1706, died at Philadelphia 17th April, 1790. He was the fifteenth of seventeen children, and was at first intended for the ministry, but was placed instead with his brother, a printer, to serve an apprenticeship to that trade. His brother having started the *New England Courant*, Franklin secretly wrote some pieces for it, and had the satisfaction of finding them well received. But, on this coming to the knowledge of his brother, he was severely lectured for his presumption, and treated with great harshness. Soon after he quitted his brother's employment, and at the age of seventeen started for Philadelphia, where he obtained employment as a compositor. Here he attracted the notice of Sir William Keith, the Governor of Pennsylvania, who induced him to go to England for the purpose of purchasing types to establish himself in business. He got work in a printing-office, and after a residence of eighteen months in London returned to Philadelphia. Here he returned to his trade, and in a short time formed an establishment in connection with a person who supplied the necessary capital. They printed a newspaper, *The Pennsylvania Gazette*, which was managed with much ability, and acquired Franklin much reputation. By his exertions a public library, improved systems of education, a scheme of insurance, &c., were established in Philadelphia. In 1732 he published his *Poor Richard's Almanack*, which continued to be issued till 1757. Being in Boston in 1746, he saw, for the first time, some experiments in electricity, which led him to begin those investigations which resulted in the identification of lightning and electricity, and the invention of the lightning-conductor. As member of the Provincial Assembly of Pennsylvania he showed himself very active, and he was sent out (in 1757) to the mother country as the agent of the province. His reputation was now such, both at home and abroad, that he was appointed agent of the provinces of Massa-

chusetts, Maryland, and Georgia. Oxford and Edinburgh conferred on him their highest academical degrees, and the Royal Society elected him a fellow. In 1762 he returned to America; but was again appointed agent in 1764, and brought to England a remonstrance against the project of taxing the colonies. He opposed the Stamp Act, and in 1774 presented to the king the petition of the first American Congress. On his return he was elected member of the Congress, and exerted all his influence in favour of the Declaration of Independence. In 1776 he was sent to France as commissioner plenipotentiary, to obtain supplies from that court. After the surrender of Burgoyne, he concluded with France the first treaty of the new states with a foreign power (1778), and was subsequently named one of the commissioners for negotiating the peace with the mother country. On his return to his native country he filled the office of President of Pennsylvania, and served as a delegate in the Federal Convention in 1787, and approved the Constitution then formed. His works include his unfinished *Autobiography* (edited by John Bigelow in 1868, and in 1888), and a great number of political, anti-slavery, financial, economic, and scientific papers. His complete works were edited by John Bigelow (1905), and by A. H. Smyth (1905-7).—BIBLIOGRAPHY: James Parton, *Life and Times of Benjamin Franklin*; P. L. Ford, *Franklin Bibliography*; J. B. McMaster, *Benjamin Franklin as a Man of Letters* (American Men of Letters Series).

Franklin, Sir John, an English Arctic explorer, born in Lincolnshire in 1786, died near Lancaster Sound 1847. He entered the navy as a midshipman at the age of fourteen, and was present at the battle of Copenhagen in 1801. He afterwards accompanied Captain Flinders on his voyage to the coast of Australia (1801-3). Shortly after his return he was appointed to the *Bellerophon*, and had charge of her signals during the battle of Trafalgar. Two years later he joined the *Bedford*, which was employed successively in the blockade of Flushing, on the coast of Portugal, and on the coast of America. On the last station she took part in the attack on New Orleans in 1814, when Franklin was slightly wounded. His Arctic work began in 1819, when he conducted an overland expedition for the exploration of the north coast of America from Hudson's Bay to the mouth of the Coppermine River. On his return to England he published a narrative of the expedition, was promoted to the rank of captain, and elected a F.R.S. In a second expedition he surveyed the coast from the mouth of the Coppermine west to Point Beechy, thus traversing in his two expeditions about a third of the distance between the

Atlantic and the Pacific. On his return in 1827 he received the honour of knighthood. After serving for some years in the Mediterranean, he held the post of Governor of Tasmania from 1836 to 1843. In 1845 he took command of the *Erebus* and *Terror* in what proved his last polar expedition. The problem was to find an Arctic water-way between the Atlantic and the Pacific. The expedition was seen in Melville Bay two months later, but from that time no direct tidings were received from it. Many expeditions were sent in search of him both from Britain and America, but with little success. At last an expedition, sent out under M'Intock in 1857, discovered in 1859, at Point Victory, in King William's Land, a document which had been deposited in a cairn thirteen years before, and gave the latest details of the ill-fated expedition. This paper stated that Sir John died 11th June, 1847; that the ships were abandoned in April, 1848; and that the crews, 105 in number, had started for the Great Fish River. None survived, but many relics of the party have been recovered. Between 1878 and 1880 Lieutenant Schwatka, of the United States army, made a final search and found other remains of Sir John Franklin's men.—*Eleanor Pordon* (1795-1825), first wife of Sir John Franklin, published several volumes of verse.—His second wife, *Jane Griffin* (1802-75), was notable for her philanthropy and her persevering efforts to clear up the fate of her husband.—BIBLIOGRAPHY: S. Osborn, *The Career, Last Voyage, and Fate of Sir John Franklin*; H. D. Truill, *Life of Sir John Franklin*.

Franklin, a name given (from Sir John Franklin, the Arctic explorer) to a district of Canada which includes the islands lying north of the mainland, with Melville Peninsula and Boothia Peninsula.

Franklin, a town of the United States, Pennsylvania, Venango County, interested in the petroleum trade. Pop. 9767. There are smaller towns of the same name in Massachusetts, New Hampshire, and Indiana respectively.

Franklinite, a mineral composed of oxide of iron 64.5 to 66, oxide of zinc 21.8, and oxide of manganese 12.23 to 13.5 per cent, belonging to the group of minerals called *spinels*. It is found in New Jersey and named after the town there. It is used for the manufacture of spiegeleisen, an iron containing 12 to 20 per cent manganese, and the zinc is recovered from the furnace gases.

Frank-pledge, literally pledge or surety for a freeman. Frank-pledge was a law prevailing in England before the Norman Conquest, by which the members of each decennary or tithing, composed of ten households, were made responsible for each other, so that if one of them committed an offence the others were bound to make reparation.

Franks. See *France*.

Franzensbad (fránts'ens-bát), a watering-place in Bohemia, Czecho-Slovakia, about 3 miles north of Eger. The mineral springs, mentioned as early as the sixteenth century, are alkaline, saline, and chalybeate, and are very efficacious, particularly in scrofulous and cutaneous affections. Pop. 1850.

Franz-Joseph Land, an island group in the Arctic Ocean, lying north of Novaya Zemlya, and consisting of two chief islands, much broken up by fiords, and a number of smaller ones.

Franzos, Karl Emil, German novelist and journalist of Jewish descent, born in Podolia in 1848, died 28th Jan., 1904. He studied law but entered journalism, lived at Vienna for some time, and then settled in Berlin, where he founded in 1886 the *Deutsche Dichtung*, a fortnightly review. In 1876 he published *Aus Itall-Asien*, wherein he described life in Roumania, Galicia, and Southern Russia. This book was translated into several languages. Other works by Franzos are: *Vom Don zur Donau* (1878), *Die Juden von Barnav* (1877), *Ein Kampf ums Recht* (1882), *Die Wahrheitsucher* (1894), and *Mann und Weib* (1897).

Frasca'ti, a town, Italy, about 10 miles S.E. of Rome, situated on the slopes of the Alban Hills, near the site of the ancient Tusculum. It is much resorted to by the people of Rome in summer-time. Charles Edward Stuart, the Young Pretender, is buried in the Cathedral of S. Pietro. Pop. about 10,500.—*Frascati* was also the name of an aristocratic gaming-house in Paris during the first quarter of the nineteenth century. It was suppressed by Louis Philippe.

Fraser, Alexander Campbell, Scottish philosophical writer, born 1819, died in 1914. He succeeded Sir William Hamilton in the professorship of logic and metaphysics at Edinburgh, in 1856, and retired in 1891. He edited the *North British Review*, and published *Essays in Philosophy*; *Bishop Berkeley's Works*, with *Life*, &c.; an edition of *Locke's Essay*; *Monographs on Locke and Berkeley*; *Biography of Thomas Reid*; *Philosophy of Theism*; *Biographia Philosophica*; *Our Final Venture*; and *Berkeley and Spiritual Realism*.

Fraser, or **Frazer**, Simon. See *Lovel*.

Fra'sera, a genus of plants, nat. ord. Gentianaceæ, containing ten species of erect perennial herbs, natives of North America. *F. carolinensis* is indigenous in the swamps of the Carolinas. The root yields a powerful bitter, similar to gentian, and used as a tonic.

Fraserburgh, a seaport of Scotland, in Aberdeenshire, 22 miles east of Banff. It is substantially built, has two harbours, a good trade, and is the chief seat of the Scottish herring-

fishery. Pneumatic-tool works have been established there. Pop. 10,514.

Fraser River, the principal river in British Columbia, rising in the Rocky Mountains. It first flows north-west for about 270 miles, then turns south, and after a total course of about 500 miles falls into the Gulf of Georgia. Gold is found both on the Fraser and its affluents, and the salmon fisheries are important. Its principal affluents are the Thomson and Stuart Rivers. New Westminster, Hope, Yale (head of navigation), and Lytton are on its banks.

Frater'nity, an association of men who unite to promote their common interest, business or pleasure. In this wide sense it includes all secret and benevolent societies, the monastic and sacerdotal congregations, the orders of knighthood, and also guilds, trades unions, and the like. In a limited sense it is applied to religious societies for pious practices and benevolent objects. These were often formed during the Middle Ages, from a desire of imitating the holy orders. Many of these societies, which did not obtain or did not seek the acknowledgment of the Church, had the appearance of separatist organizations, and incurred the charge of heresy. The pious fraternities which were formed under the direction of the Church, or were acknowledged by it, were either required by their rules to afford assistance to travellers, to the unfortunate, the distressed, the sick, and the deserted, on account of the inefficiency of the police, and the want of institutions for the poor, or to perform certain acts of penitence and devotion. Of this description were the *Frates Pontifices*, a brotherhood that originated in Tuscany in the twelfth century, where it maintained establishments on the banks of the Arno, to enable travellers to cross the river, and to succour them in case of distress. A similar society was afterwards formed in France, where it built bridges and hospitals, maintained ferries, kept the roads in repair, and provided for the security of the highways. Similar to these were the *Knights and Companions of the Santa Hermandad* (or *Holy Brotherhood*) in Spain; the *Familars and Cross-bearers* in the service of the Spanish Inquisition; the *Calendar Brothers* in Germany; and the *Alexians* in Germany, Poland, and the Netherlands. The professed object of the Alexians, so called from Alexius, their patron saint, was to visit the sick and imprisoned; to collect alms for distribution; to console criminals, and accompany them to the place of execution; to bury the dead, and to cause masses to be said for those who had been executed, or for persons found dead. There were also *Grey Penitents* (an old fraternity of an order existing as early as 1264 in Rome, and introduced into France under Henry III); the black fraternities of *Mercy* and

of *Death*; the *Red*, the *Blue*, the *Green*, and the *Violet Penitents*, so called from the colour of their cowl; the divisions of each were known by the colours of the girdle or mantle. The fraternity of the *Holy Trinity* was founded at Rome in 1548 by Philip de' Neri for the relief of pilgrims and the cured dismissed from the hospitals. The *Brothers of Charity* are another fraternity whose hospitals are found in all the principal cities of Catholic Christendom.

Fraticelli (frā-ti-chel'lē; the diminutive plural of It. *frate*, brother or monk), the name given about the end of the thirteenth and during the fourteenth century, and even later, to wandering mendicants of different kinds, but especially to certain Franciscans, who pretended to practise the rules of their order in their full rigour. They claimed to be the only true Church, and denounced the Pope, whose authority they threw off, as an apostate. They made all perfection consist in poverty, forbade oaths, and discountenanced marriage, and were accused by their opponents of very lewd practices. The sect, which was mercilessly persecuted during the fifteenth century (from 1426 to 1449, and from 1466 to 1471), is said to have continued till the Reformation, which they assisted.—Cf. H. C. Lea, *History of the Inquisition of the Middle Ages*.

Fraud (Lat. *fraus*, deceit), an act or course of deception deliberately practised with the view of gaining an unlawful or unfair advantage, such as the obtaining of goods under false pretences, and the like. All frauds or attempts to defraud, which cannot be guarded against by common prudence, are indictable at common law, and punishable arbitrarily according to the heinousness of the offence. Every species of fraud of which the law takes cognizance renders voidable every transaction into which it enters as a constituent material element. Fraud may be by false representation, concealment of material circumstances that ought to be revealed, underhand dealing, and by taking advantage of imbecility or intoxication. A constructive fraud in law is such fraud as is involved in an act or contract, which though not originating in any actual evil or fraudulent design, yet has a tendency to deceive or mislead other persons, or to violate public or private confidence, or to impair or injure the public interests. The *Statute of Frauds* was the statute 29 Charles II c. 3, passed 1677. Among its complex provisions it provided that various transactions should be in writing, or evidenced by some memorandum in writing, signed by the party who is sought to be made liable thereon; else they shall, for most or all purposes, be deemed invalid.—Cf. Kerr, *Treatise on the Law of Fraud and Mistake*.

VOL. V.

Fraunhofer (froun'hō-fēr), Joseph von, German optician, born 1787, died 1826. Apprenticed in 1799 to a glass-polisher in Munich, he ultimately became a partner in a manufactory of optical instruments there. His many improvements in glass-making, in optical instruments, and in the polishing of lenses, have been eclipsed by his investigation of the innumerable dark fixed lines in the solar spectrum, known as *Fraunhofer's Lines*. The importance of this discovery can scarcely be overestimated. It led to the invention and use of the spectroscope, to the science of spectroscopy, and to all our present knowledge of solar and stellar chemistry. See *Spectrum*; *Spectroscope*.

Fraxinella, a species of dittany, the *Dictamnus Fraxinella*, an ornamental herbaceous annual plant, cultivated for its fragrant leaves and handsome rose-coloured flowers.—*Dictamnus albus*, or common dittany, is also called fraxinella; its flowers are white.

Fraxinus, a genus of deciduous trees of the ord. Oleaceæ, containing the ash.

Fray Bentos (fri), a small town of Uruguay, on the River Uruguay, about 170 miles northwest of Monte Video. It owes its existence to immense slaughter-houses and other establishments connected with the extract-of-meat trade. Pop. about 5000.

Frazer, Sir James George, classical scholar and anthropologist, was born in Glasgow in 1854, studied at Trinity College, Cambridge, and graduated with high distinction in classics in 1878. He was called to the Bar at the Middle Temple in 1882. He is a Fellow of Trinity College, Cambridge, became professor of social anthropology at Liverpool in 1907, and has received honorary doctor's degrees from several universities, including that of Paris in Nov., 1921. He was knighted in 1914. His publications include: *Totemism* (1887); *The Golden Bough: a Study in Comparative Religion* (1890); *Pausanias' Description of Greece* (Translation and Commentary, 1898); *Pausanias and other Greek Sketches* (1900); *Lectures on the Early History of the Kingship* (1905); *The Scope of Social Anthropology* (1908); *Totemism and Exogamy* (1910); *Folklore in the Old Testament* (1918). In his chief work, *The Golden Bough*, there are brought together a mass of material and a number of ingenious theories and speculations bearing on the origin of religion and religious beliefs, the folklore of many peoples being brought under review.

Fréchette (frā-shet'), Louis Honoré, a French Canadian author, born at Levis, Quebec, 1839, died in 1908. He was educated at Nicolet College and Laval University, studied law and was called to the Bar of Lower Canada, represented his native county in the Dominion Parliament (1874-9), contributed to various news-

papers, and became editor of *La Patrie* in Montreal in 1884. He published collections of poems entitled *Mes Loisirs*, *Les Fleurs Boréales*, and *Les Oiscaux de Neige* (the two last crowned by the French Academy); the dramas of *Félix Poultré* (1862), *Papineau* (1880), *The Thunderbolt* (1882), &c. In prose he wrote *Petite Histoire des Rois de France*, and *Lettres à Basile*.

Freckles, small yellow or greenish-yellow spots of a circular form, situated in the middle layer of the skin and underneath the cuticle. They only appear to any appreciable extent on those surfaces exposed to the action of the sun, as the neck, face, hands, and arms. This affection is most common in persons of fair complexion and hair; in some cases it is permanent, but in most it disappears with the warm season.

Fredegonde, the wife of Chilperic, a Frankish king of Neustria, born 543, died 597. While in the service of the first and second wives of Chilperic her beauty captivated the king. In order to arrive at the throne Fredegonde got Audovera, the first wife of the king, removed by artifice, and the second (Galswintha) by assassination (568). This led to a war between Chilperic and his brother Sigebert, King of Austrasia, Brunchilde, wife of Sigebert and sister of the murdered queen, urging her husband to vengeance. Fredegonde found means to have Sigebert assassinated, took Brunchilde and her daughters, and after a series of crimes, ending with the assassination of her husband, she seized the reins of government on behalf of her son Clothaire, and retained possession of them until her death.

Fredericia, a seaport of Denmark, in Jutland, at the north entrance of the Little Belt. In 1849 the army of Schleswig-Holstein was defeated there by the Danes, and in 1864 the Danes were compelled to evacuate it before the superior Austro-Prussian forces. A bronze statue, *The Danish Soldier*, was erected here in commemoration of the victory of 1849. Pop. 14,228.

Frederick, a town in the United States, in Maryland, 44 miles N.W. of Baltimore. It has an extensive trade, chiefly in live stock, grain, flour, tobacco, and wool. During the Civil War it was occupied on different occasions by the opposing armies. Pop. 11,066.

Frederick I, Barbarossa (or, as the Germans call him, Rothbart, both surnames meaning 'Red-beard'), Roman emperor, son of Frederick, Duke of Suabia, was born 1121, drowned in 1190. He received the imperial crown in 1152 on the death of his uncle the Emperor Conrad III. His principal efforts were directed to the extension and confirmation of his power in Italy. In his first expedition to Italy in 1154 he subdued the towns of Northern Italy, and then got himself crowned at Pavia with

the iron crown of Lombardy (April, 1155), and afterwards at Rome by Pope Adrian IV with the imperial crown (June, 1155). Soon after his return to Germany the Lombard cities revolted, and Frederick led a second expedition into Italy (1158), took Brescia and Milan, and at the Diet of Roncaglia, at which all the cities and imperial vassals of Italy were represented, he assumed the sovereignty of the towns and received the homage of the lords. The rights assigned to the empire were so great that many of the cities refused to acknowledge them, and Milan especially prepared for resistance. Meantime Pope Adrian IV died (1159), and in electing a successor the cardinals were divided, one section choosing Victor IV and another Alexander III. Frederick supported Victor, and Alexander was compelled to flee from Italy and take refuge in France. Other expeditions into Italy were made in 1161 and 1166, in the latter of which Frederick at first carried everything before him, and was even able to set up in Rome the Anti-Pope Paschalis III, whom he supported after the death of Victor IV. His successes were put an end to, however, by a terrible pestilence, which carried off a large part of his army, and compelled him hastily to return to Germany. Scarcely had he settled the most pressing difficulties here when he undertook, in 1174, a fifth expedition into Italy; but he was totally defeated in the battle of Legnano on the 29th of May, 1176, in consequence of which nearly all that he had won in Italy was again lost, and he was compelled to acknowledge Alexander III as the true Pope. In 1188 he assumed the cross, and with an army of 150,000 men and several thousand volunteers set out for Palestine. After leading his army with success into Syria, he was drowned in crossing the River Kalykadnus (now Geuksu), 1190.—BIBLIOGRAPHY: J. Jastrow, *Deutsche Geschichte im Zeitalter der Hohenstaufen*; H. Prutz, *Kaiser Friedrich I*.

Frederick II, Hohenstaufen, grandson of the preceding, born 1194, died in 1250. He was the son of the Emperor Henry VI and of the Norman Princess Constance, heiress of the Two Sicilies. He remained under the guardianship of Innocent III till 1209, when he took upon himself the government of Lower Italy and Sicily. The imperial crown of Germany was now worn by a rival, Otho IV, whose defeat at the battle of Bouvines opened the way to Frederick, and in 1215, after pledging himself to undertake a crusade, he was crowned at Aix-la-Chapelle. He caused his eldest son Henry to be chosen King of Rome in 1220, and the same year received the imperial crown from the Pope. His ambition aimed at the subjugation of Lombardy, the mastership of all Italy, and the reduction of the Popes to their old spiritual office as the

leading bishops in Christendom. This led him into constant struggles in Germany and Italy. In 1227 he undertook a crusade; but when he did reach the Holy Land he was able to effect nothing permanent, although he had crowned himself at Jerusalem as King of Judea. On his return he had to suppress a revolt of his son Henry, whom he imprisoned for life. In 1237 he broke the power of the Lombard League by a victory at Corte Nuova in Lombardy, and marched on Rome, but did not attack it. The remainder of his life was occupied with his troubles in Italy, and he died in the midst of his wars. He was one of the ablest and most accomplished of the long line of German emperors, and art, literature, commerce, and agriculture received every encouragement at his hands. He himself was a good linguist, was acquainted with natural history, was a minnesinger, and a writer on philosophy. — BIBLIOGRAPHY: J. Jastrow, *Deutsche Geschichte im Zeitalter der Hohenstaufen*; L. Allshorn, *Stupor Mundi: the Life and Times of Frederick II.*

Frederick I, King of Prussia, son of the great Elector, born 1657, died 1713. He succeeded his father as Elector of Brandenburg in 1688, became King of Prussia in 1700, and was all his reign bitterly opposed to France.

Frederick II, King of Prussia, known as Frederick the Great, born 1712, died 1786. He was the son of Frederick William I and the Princess Sophia Dorothea of Hanover, sister of George II of England. Although he was instructed only in the details of military exercises and service, his taste for poetry and music was early developed. He was brutally treated by his father, and in 1733 was obliged to marry the Princess Elizabeth Christina, daughter of Ferdinand Albert, Duke of Brunswick-Bevern. Frederick William gave the castle of Schönhausen to her, and to the prince the county of Ruppin, and in 1734 the town of Rheinsberg, where he lived, devoting himself chiefly to literary pursuits, composing several works, and corresponding with foreign scholars, particularly with Voltaire, whom he greatly admired. The death of his father raised him to the throne in 1740, and it was not long before he asserted the claims of the House of Brandenburg to a part of Silesia then held by Maria Theresa. But his proposals being rejected, he occupied Lower Silesia in Dec., 1740, defeated the Austrians near Mollwitz and at Czaslau (Chotusitz), and the first Silesian War was terminated by the peace signed at Berlin, 28th July, 1742, leaving Frederick in possession of Silesia. Soon the second Silesian War broke out, the result of which was equally favourable to Frederick. By the Peace of Dresden (15th Dec., 1745) he retained Silesia and acknowledged the husband of Maria Theresa,

Francis I, as emperor. During the eleven following years of peace Frederick devoted himself to the domestic administration, to the improvement of the army, and at the same time to the muses. He encouraged agriculture, the arts, manufactures, and commerce, reformed the laws, increased the revenues of the State, and perfected the organization of his army, which was increased to 160,000 men. Secret information of an alliance between Austria, Russia, and Saxony gave him reason to fear an attack and the loss of Silesia. He hastened to anticipate his enemies by the invasion of Saxony (1756), with which the Seven Years' War, or third Silesian War, commenced. This was a far more severe struggle than either of the former. In it Frederick had against him Austria, Russia, France, Sweden, and the greater part of Germany, though Britain and some of the German states were on his side. He gained victories at Prague, Rossbach, Leuthen, Zorndorf, Torgau, Freiberg, but suffered severe defeats in the battles of Kollin, Hochkirch, and Kunersdorf. (See *Seven Years' War*.) The Peace of Hubertsburg (1763) terminated this war, Frederick keeping Silesia and ceding nothing. Frederick came out of the Seven Years' War with a reputation which promised him in the future a decisive influence in the affairs of Germany and Europe. His next care was the relief of his kingdom, drained and exhausted by the contest. This he prosecuted with great diligence and liberality. On the partition of Poland in 1772 Frederick received a large accession to his dominions. In 1778–9 he frustrated the designs of the Emperor Joseph II on Bavaria, and the war of the Bavarian Succession was terminated without a battle by the Peace of Teschen (13th May, 1779). Austria consented to the union of the principalities of Franconia with Prussia, and renounced the feudal claims of Bohemia to those countries. In the evening of his active life Frederick concluded, in connection with Saxony and Hanover, the Confederation of the German princes, 23rd July, 1785. An incurable dropsy hastened the death of Frederick, who left to his nephew, Frederick William II, a kingdom increased by 20,000 sq. miles, a well-filled treasury, an army of 200,000 men, great credit with all the European powers, and a state distinguished for population, industry, wealth, and science. Frederick's works, relating chiefly to history, politics, military science, philosophy, and the belles-lettres, were all written in French, the language which he regularly used, as he despised German. He was a man of the highest abilities, but in some respects narrow and repellant. Among his closest friends was the Scottish exile Marshal Keith. Carlyle's *History of Frederick* is well known. — BIBLIOGRAPHY. E. Lavissee, *La jeunesse du grand*

Frédéric; Lavissee and Rambaud, *Histoire Générale* (vol. ii); E. Daniels, *Frederick the Great and his Successor* (in Cambridge Modern History); F. T. Kugler, *Life of Frederick the Great*; Sir E. M. Satow, *The Silesian Loan and Frederick the Great*.

Frederick III, Emperor of Germany, born 1831; succeeded William I 9th March, 1888; died 15th June, 1888. In 1858 he married the Princess-Royal of Britain, eldest daughter of Queen Victoria. He commanded the army of the Oder in the war with Austria (1866), and in the Franco-German War he led the army which ultimately forced Napoleon III and his army to surrender at Sedan. He also took a prominent part in the siege of Paris. In 1887 he was attacked by a serious throat affection, which turned out to be cancer, and which after a series of relapses proved fatal. His renown as a military commander, his liberal views, his patience and fortitude under trouble, and his many lovable qualities made him extremely popular.

Frederick VIII, King of Denmark, born in 1843, died suddenly at Hamburg on 14th May, 1912. He was the eldest son of Christian IX, married in 1860 Princess Louise of Sweden, a niece of King Oscar II, and succeeded to the throne of Denmark in 1906. His second son Charles became King of Norway in 1905, under the name of Haakon VII.

Frederick Augustus I and II, Electors of Saxony and Kings of Poland. See *Augustus II and III*.

Frederick Charles, Prince, known as the 'Red Prince', born 1828, died 1885. He was nephew to the Emperor William I, and gained fame for his military exploits during the wars of 1866 and 1870. Sadowa, Thionville, Gravelotte, and St. Privat are among his chief achievements.

Fredericksburg, a town, United States, Virginia, on the Rappahannock, 60 miles north by east of Richmond. Here the Federal forces under Burnside were defeated by the Confederates under Lee on the 13th Dec., 1862. Pop. 5874.

Frederickstad, a town of Norway, at the mouth of the Glommen, 48 miles S.E. of Christiania. Formerly strongly fortified; it has an arsenal; manufactures hardware, pottery, &c., and has some shipping and general trade. Pop. 15,597.

Frederick William, of Prussia, generally called the *Great Elector*, was born in 1620, died 1688. At the age of twenty he succeeded his father as Elector of Brandenburg. He must be considered as the founder of the Prussian greatness, and as the creator of a military spirit among his subjects. His reign began when the unhappy Thirty Years' War was still raging in Germany,

and his conduct towards both parties was prudent. He succeeded in freeing Prussia from feudal subjection to Poland; and obtained possession of Pomerania in 1648. In 1672 he concluded a treaty with the Dutch Republic when that state was threatened by Louis XIV. In 1673 he concluded a treaty by which France promised to evacuate Westphalia, and to pay 800,000 livres to the Elector, who, in return, broke off his treaty with Holland, and promised not to render any aid to the enemies of France. In 1674 the German Empire declared war against France. The Elector marched 16,000 men into Alsace, but a Swedish army having been induced to invade Prussia, Frederick turned back and totally defeated them at Fehrbellin (1675). Some years after the Swedes again invaded his territories, but were driven back. France, however, demanded the restoration of all the conquered territories to Sweden. The Elector, having refused compliance, formed an alliance with Denmark, and waged a new war against Sweden, but was at last obliged to submit. He paid great attention to the promotion of agriculture and horticulture, and, by affording protection to the French refugees, gained 20,000 industrious manufacturers, who were of the greatest advantage to the north of Germany. Berlin was much improved during his reign. He left to his son a country much enlarged and improved, an army of 28,000 men, and a well-supplied treasury. —Cf. Sir A. W. Ward, *The Great Elector and the First Prussian King* (Cambridge Modern History).

Frederick William I, King of Prussia, son of Frederick I and father of Frederick the Great (II), was born in 1688, died 1740. While Crown Prince (1706) he married Sophia Dorothea, daughter of the Elector of Hanover, afterwards George I of England. On his accession to the throne, in 1713, he endeavoured to increase the army and reform the finances, and became the founder of the rigid discipline regarded as characteristic of Prussian troops. His ridiculous fondness for tall recruits is well known. He was very miserly, eccentric, and arbitrary. He opposed Charles XII, and was the protector of the neighbouring Protestant states. He left behind him an abundant treasury, and an army of about 70,000 men. His affairs were in the greatest order and regularity, and to his energy Prussia was much indebted for that prosperity and success which distinguished her till she was humbled by the power of Napoleon.

Frederick William II, King of Prussia, born 1744, died 1797. He succeeded his uncle Frederick the Great in 1786, and shared in the second partition of Poland.

Frederick William III, son of Frederick William II, born 1770, died 1840. During his

reign Prussia suffered much at the hands of Napoleon, sustaining defeats at Jena, Eylau, and Friedland, and lost a large portion of territory, which, however, was recovered after the fall of Napoleon.

Frederick William IV, King of Prussia, son of Frederick William III, was born 1795, died 1861. He was carefully trained by the best masters in all the leading branches of knowledge and art, civil and military. He took part, though without any active command, in the campaigns of 1813 and 1814. When he succeeded to the throne on the death of his father in 1840, his first proceedings were both of a popular and praiseworthy character. He soon, however, began to pursue a retrograde and absolutist policy. The popular movement which followed the French revolution of 1848 was at first met by the king with firmness, but on the demand of the people that the troops should be withdrawn from the capital, backed by an attack on the arsenal, the king offered concessions, which, however, as soon as he felt himself strong enough to do so, he retracted. Afterwards his mind gave way, and he sank into a state of hopeless imbecility, which rendered it necessary to appoint his brother William regent of the kingdom. He died without issue, and was succeeded by his brother, who ten years later became emperor of united Germany.

Fredericton, the capital of New Brunswick, Dominion of Canada, on the River St. John, about 84 miles from its mouth, and 54 miles N.N.W. of the town of St. John. It is well laid out, and has handsome public buildings, including the Government house, the provincial buildings, court-house, town hall, cathedral, and university. The trade is extensive and increasing, the river being navigable for large steamers. Pop. 7208.

Fred'erikshald, or Frederikshall, a seaport, Norway, at the mouth of the Tistedal in the Idde-fiord, about 60 miles S.S.E. of Christiania. Immediately to the south stands the fortress of Frederiksteen, at the siege of which Charles XII of Sweden was killed, 30th Nov., 1718. An obelisk marks the spot. Pop. 11,992.

Frederikshavn, a seaport of Denmark, in Jutland, on the Cattegat, with a large export of agricultural produce, its harbour being much resorted to for shelter. Pop. 7916.

Free-bench, in law, the right which a widow has, in some parts of England, in her husband's copyhold lands, corresponding to dower in the case of freeholds.

Free Church of England, an Episcopal body separate from the Established Church of England, founded in 1844 as a counteracting influence to the tractarian movement. The churches belonging to it, though not numerous, are widely

spread. The service is practically identical with that of the Evangelical party of the National Church. The Church is governed by two bishops, and has about 30 churches and 1300 members.

Free Church of Scotland, a Presbyterian Church organized as a separate body from the Established Church in May, 1843. The Queen Anne Act of 1712, which restored patronage in Scotland, was for long the chronic cause of schism and discontent in the Scottish Church, unwelcome clergymen being often under it appointed to church livings. In 1834 the General Assembly passed a *вето act*, which declared that no minister should be intruded into a parish church against the will of the people, and that a majority of male heads of families, full members of the church, should be able to bar an obnoxious presentee. This act before long created litigation, and the ecclesiastical and civil powers came into conflict. The struggle was brought to an issue by the judgment of the House of Lords in 1842, affirming a decree of the Court of Session, which required the Presbytery of Auchterarder to induct the presentee to Auchterarder parish without regard to the dissent of the parishioners. In May, 1843, the members of the General Assembly had been elected and were convened at Edinburgh, when the Rev. Dr. David Welsh, who had been Moderator of the last Assembly, instead of constituting the meeting in the ordinary manner, rose and read a protest, pointing out that the civil courts had undue powers of interference with the Established Church, and concluding by asserting the right of the protesters, in the circumstances, to withdraw to a separate place of meeting for the purpose of taking steps on behalf of themselves and their adherents for separating in an orderly way from the Establishment, but still maintaining the Confession of Faith and Standards of the Church of Scotland as heretofore understood. After reading this document the Moderator and other members of Assembly, together with those adhering to them, withdrew to another place of meeting (the Tanfield Hall, Canonmills), and constituted themselves the Free Church of Scotland. They elected Dr. Chalmers as their Moderator, and proceeded with the business before them. Although thus denuded of the temporal benefits of an establishment, they declared themselves to be the true National Church of the Reformation, and did not object to the endowment and establishment of religion by the State. In late years, however, a decided majority of the Free Church clergy gave up the doctrine of the lawfulness of the establishment of the Church by the State, and became converts to the 'voluntary principle'. The deed of demission, or resignation of livings, was signed by 474 ministers and professors. A sustentation

fund was instituted for the maintenance of the ministers, to be supplied by the voluntary offerings of the people. In the first year after the disruption the sum of £386,719 was contributed for the erection of churches, between 700 and 800 of which had to be provided for congregations which left the Establishment with their ministers. Colleges for the theological training of the ministry were subsequently erected in Edinburgh, Glasgow, and Aberdeen. Schools were added to the churches in town and country, and normal schools for the training of teachers were instituted. In 1900 the Free Church joined the United Presbyterian Church (established in 1847 on the voluntary principle), to form the United Free Church of Scotland. A small minority of Free Church ministers and members, who were nicknamed the 'Wee Frees', refused to accept the union and claimed to be the true Free Church of Scotland, a claim which the law decided in their favour, the Church property passing in accordance with the decision. The inability of the (new) Free Church to make full use of the churches and other property thus assigned led to legislative interference and to a Royal Commission of Inquiry. In 1905, following on the Commissioners' report, an Act of Parliament, The Churches (Scotland) Act, was passed, under which an Executive Commission was set up for the purpose of allocating the property in proportion to the number of the adherents. The Free Church consists of 5 synods, 12 presbyteries, and foreign missions. In 1919 there were 150 congregations and 89 ministers.—BIBLIOGRAPHY: R. H. Story, *The Church of Scotland*; W. Stephen, *History of the Scottish Church*; A. M. Stewart, *Origins of the United Free Church in Scotland*; Peter Bayne, *The Free Church of Scotland*.

Free Cities, cities having an independent government of their own, and virtually forming states by themselves; a name given to certain cities of Germany which were members of the German Confederation, and exercised sovereign jurisdiction within their own boundaries. At the time of the French Revolution the free or 'imperial' cities numbered no fewer than fifty-one; but all except Hamburg, Lübeck, and Bremen have been deprived of their special privileges.

Free Companies, or Free Lances, names given to the bodies of private adventurers who, in the Middle Ages, organized themselves into bands of mercenary soldiers, and let out their services to the highest bidder. They played their most conspicuous part in Italy, where they were called *Condottieri*.

Freedmen (*liberti, libertini*) was the name applied by the Romans to those persons who had been released from a state of servitude.

The freedman wore a cap or hat as a sign of freedom (hence the origin of the cap of liberty), assumed the name of his master, and received from him a white garment and a ring. With his freedom he obtained the rights and privileges of a Roman citizen of the plebeian rank, but could not be raised to any office of honour.

Freedom of the City. The 'freedom' of a city or corporate town is a privilege which, tracing its descent from the rights of the Roman *civis*, is enjoyed by 'freemen' of the place. These formerly attained it either by birth, as being the sons of freemen; by serving an apprenticeship of seven years to a freeman resident in the borough; or, until the right was abolished by the Municipal Corporation Act of 1835, by purchase. Since an Act of 1882 a burgess is a man (or woman) of full age who has occupied a house, resided for a year in the borough, paid poor and borough rates, and had his name recorded on the Burgess Roll. Freedom of a city may also be acquired by a formal gift, and it is in this connection that the phrase is largely used, it being a common custom for London and other towns, both in England and Scotland, to bestow the privilege on persons of high rank, prominently successful military or naval commanders, distinguished explorers, and persons otherwise eminent. In 1899 women became qualified for the honour, a compliment bestowed alike upon strangers to the borough and natives or residents; the former, however, have no right to exercise the municipal franchise or to become members of the borough council. A distinction between English and Scottish corporations is the power of Scottish magistrates to create burgesses by election. The Burgess Roll of an English borough has its Scottish equivalent in the Register of Municipal Electors.

Freedom of the Seas. This phrase has two meanings. It may signify the right of any nation to use the seas for commercial purposes in time of peace, and may thus be connected with early protests against the claims of certain countries to exclude foreign ships from portions of the ocean. In the Middle Ages, Venice asserted a sovereignty over the whole of the Adriatic Sea and levied tributes from foreign vessels, and, after the discovery of the New World, Spain claimed exclusive rights in the Western Atlantic, in the Gulf of Mexico, and in the Pacific, and Portugal had similar pretensions in the Indian Ocean. These controversies have long been settled by the universal recognition of the freedom of the seas in this sense, and the claims of natives to control tracts of sea near their own coasts have been abandoned in favour of the adoption of an international admission of a three (or sometimes four) mile limit of territorial sovereignty over the seas adjacent to

any country. The use of the open sea by any nation in time of peace is now taken for granted, and the phrase 'freedom of the seas' in modern conversational usage is always understood to refer to time of war. Under conditions of war, a belligerent Power not only attempts to close the seas against its enemies, but also, for certain purposes, against neutrals. All enemy shipping is recognized by international custom to be liable to destruction or seizure, and no distinction is drawn between purely commercial shipping and ships of war, or between cargoes useful for military purposes and other classes of goods; the only limits to belligerent action in this respect are those imposed by considerations of humanity. In regard to neutrals, a belligerent Power claims the right to stop neutral vessels to search them, to confiscate goods likely to assist the military purposes of the enemy (contraband of war), and even to confiscate vessels which can be proved to be employed in the enemy's behalf, provided that the lives of crews and passengers are preserved. The position of Great Britain as a maritime Power has rendered it necessary, from time to time, to insist upon the legality of these principles, and the assertion of them has sometimes brought about the conversion of neutrals into enemies.

In the War of American Independence (1776-83), a rival theory was propounded, to the effect that 'free ships make free goods', and that anything might be carried under a neutral flag. After the French entered into the war, they recognized this principle on condition that the neutral Powers should compel Great Britain to follow the French example, and it was in this connection that the phrase 'the freedom of the seas' first became a technical term. In 1780 Russia, Denmark, Sweden, Prussia, and Austria formed an 'Armed Neutrality' against Great Britain in order to establish a rule that "a Power at war has no right to interrupt the commerce of the subjects of a neutral Power". Holland, which also joined the Neutrality League, soon entered into the war against Great Britain. The League promised to prohibit their own nationals from carrying contraband of war, but such a promise was obviously worthless, and to the end of the struggle Great Britain maintained her attitude. The question again became important in the course of the great French war, and in 1800 Russia, Sweden, Denmark, and Prussia formed the second Armed Neutrality, which aimed at compelling Great Britain to recognize 'the freedom of the seas'; but the murder of the Czar Paul and the battle of Copenhagen put an end to the League. In the later stages of the war, Napoleon justified the prohibition of trade with Great Britain by his Berlin and Milan decrees as a policy of retaliation against British

interference with the freedom of the seas, and the enforcement of the blockade by the British Orders in Council led to the war of 1812-4 with the United States. The attitude neither of France nor of the Powers of the Armed Neutrality had been consistent throughout the period 1780-1815. All of them had shown that they advocated their principle of the 'freedom of the seas' only when it suited them, and that they were ready to abandon it when it became inconvenient.

In the course of the nineteenth century, the general principles of the right of search by belligerent Powers and of the seizure of contraband goods came to be accepted as a rule of international law. In the European War of 1914-8, the Germans revived the cry of the 'freedom of the seas', but with little attempt to disguise the fact that their real aim was to establish a German maritime predominance. In their conduct of the naval war, they deliberately violated international law in two respects. The destruction of enemy merchant vessels was admitted to be legitimate only if the safety of the crews and passengers was secured, and in former wars enemy merchant vessels were released if no provision could be made for those on board. The Germans, from an early stage in the war, sunk enemy merchant ships without warning, and without the possibility of preserving the lives of their victims. At a later stage in the war they broke the further rule that neutrals are immune from hostile attack, and that, although neutral vessels are liable to examination and in certain circumstances to seizure, the lives of neutral seamen and passengers are to be held inviolate. The defeat of the Central Powers has disposed of the inhuman contentions of the former German Government, and the general question of the rights of belligerents at sea is one of the matters on which the League of Nations will have power to legislate. One of the 'fourteen points' which President Wilson described as essential for a permanent peace was "absolute freedom of navigation upon the seas, alike in peace and in war, except as the seas may be closed in whole or in part by international action for the enforcement of international covenants". This clause, which has no counterpart in the Peace Treaty, was interpreted as an attack upon British theory and practice, but provision is made for the British contention in the exception made for the closure of the seas by international agreement.

Freehold, in law, an estate in real property, held either in *fee-simple* or *fee-tail*, in which case it is a freehold of inheritance, or for the term of the owner's life; also, the tenure by which such an estate is held. Freehold is to be distinguished from *copyhold* and *leasehold* (q.v.).

Freeman, Edward Augustus, English historian and archaeologist, born 1823, educated at Trinity College, Oxford, of which he was scholar and fellow; died in 1892. He received various academical distinctions, and in 1884 became regius professor of modern history at Oxford. His works, which are very voluminous, include: *History of Architecture* (1849), *History and Conquests of the Saracens* (1856), *History of Federal Government* (1863), *Old English History* (1869), *Growth of the English Constitution* (1872), *Historical Essays* (1872-9), *History of the Norman Conquest* (1867-76), *Historical Geography of Europe* (1881), *The Reign of William Rufus* (1882), and *History of Sicily* (unfinished, 1891-2). —Cf. W. R. W. Stephens, *Life and Letters of E. A. Freeman*.

Freemasonry, a term applied to the organization of a society calling themselves *free* and accepted *masons*, and all the mysteries therewith connected. This society, if we can reckon as one a number of societies, many of which are unconnected with each other, though they have the same origin and a great similarity in their constitution, extends over almost all parts of the globe, and is consequently of the greatest service to travellers who are members of the craft. According to its own peculiar language, it is founded on the practice of social and moral virtue. It claims the character of charity in the most extended sense; and brotherly love, relief, and truth are inculcated in it. It has been defined as "a peculiar system of morality, veiled in allegory and illustrated by symbols". Fable and imagination have traced back the origin of freemasonry to the Crusaders and the Rosicrucians, to the Roman Empire, to the Pharos, the temple of Solomon, the Tower of Babel, and even to the building of Noah's ark. According to the legendary history contained in a number of MSS., known as the *Old Charges of British Freemasons*, masonry was originated in Egypt by Euclid and spread into various countries, reaching England in the time of St. Alban (A.D. 300). In reality freemasonry took its rise in the Middle Ages along with other incorporated crafts. Skilled masons moved from place to place to assist in building the magnificent sacred structures—cathedrals, abbeyes, and churches—which had their origin in these times, and it was essential for them to have some signs by which, on coming to a strange place, they could be recognized as real craftsmen and not impostors. Freemasonry in its modified and more modern form dates only from the seventeenth century. In 1717 the First Grand Lodge was established in London. The modern ritual is said to have been partly borrowed from the Rosicrucians and knights templars, and partly devised by Elias Ashmole, the founder of the Ashmolean Museum.

Freemasonry, thus modified, soon began to spread over the world. In 1725 it was introduced into France by Lord Derwentwater; and in 1733 the first American lodge was established. The United Grand Lodge of England recognizes only two species of Freemasonry—the *Craft* and the *Royal Arch*; Scottish, Irish, American, and Continental lodges acknowledge higher degrees; but these, with the exception of the *Mark Degree*, are not universal. In ordinary freemasonry there are three grades—those of apprentice, fellow-craft, and master-mason—each of which has its peculiar initiatory ceremonies; the last of these grades, however, is necessary to the attainment of the full rights and privileges of brotherhood.—BIBLIOGRAPHY: R. F. Gould, *History of Freemasonry*, and *A Concise History of Freemasonry*; E. Conder, *Records of the Hile Craft and Fellowship of Masons*.

Free Port (It. *Porto franco*), a harbour where ships of all nations may enter on payment of a moderate toll, and load or unload. Goods may be stored at first at free ports without paying any duty; the goods may then be either re-shipped for export on paying a mere transit duty, or they may be admitted for home consumption on payment of the usual full customs of the country. Free ports have never existed in Great Britain.

Freeport, capital of Stephenson County, Illinois, 120 miles w. by n. of Chicago; the seat of a Presbyterian college; it manufactures machinery and carpets. Pop. 17,567.

Free-soil Party, a political organization formed (1847-8) in the United States, was recruited largely from the Abolitionist, Anti-Slavery Whig, and New York Democratic parties; its purpose was to oppose the introduction of slavery into the territories. At the National Convention held at Buffalo in 1848 it took as its watchword "Free Soil, Free Speech, Free Labor, and Free Man"; declared that Congress had "no more power to make a Slave than to make a King"; and nominated for the respective offices of President and Vice-President, Martin Van Buren and Charles Freeman Adams. 291,263 popular votes were given for the Free-soil candidates, but no elective vote. Nevertheless, the party was sufficiently powerful to return two Senators and fourteen representatives to the thirty-first Congress. At the Pittsburg National Convention of 1852 John P. Hale and George W. Julian were the chosen presidential candidates, and it was resolved that slavery was "a sin against God and a crime against Man". But the popular vote fell to 156,149, and, as before, no elective vote was secured. Two years later the 'Free-soilers' became absorbed in the Republican party.

Free Spirit, Brethren of the, a sect of

heretics which originated in Alsace in the thirteenth century, and quickly became disseminated over Italy, France, and Germany. They claimed 'freedom of spirit', and based their claims on *Rom. viii, 2-14*: "The law of the spirit . . . hath made me free from the law of sin and death". Thence they deduced that they could not sin, and lived in open lewdness, going from place to place accompanied by women under the name of 'sisters'.

Free-thinkers. See *Rationalism*.

Freetown, a seaport, West Africa, capital of the British West African colony of Sierra Leone, near the mouth of the estuary or river of Sierra Leone, in the vicinity of extensive swamps. Its principal streets are broad and straight, and have a very attractive appearance. Among the public buildings are several churches, a governor's house, and barracks. It has a good harbour, and is a coaling-station. Pop. 40,000.

Free-trade, the principle under which international commerce is freed from every form of Government manipulation, such as tariffs, bounties, or restrictive legislation in the interest of particular classes of producers. In all countries it was long held to be of importance to encourage native production and manufactures by excluding from their own markets, and from the colonial markets over which they had control, the competing produce and manufactures of other countries. The Physiocrats in France, and in this country Adam Smith, in *The Wealth of Nations*, had, however, already advocated the principle of free-trade in the eighteenth century, and beginnings of the movement towards free-trade were made by Pitt in 1786 and by Huskisson in 1823-5; but the great body of British commercial legislation was based until 1846 on the theory of protection. The battle for free-trade in the United Kingdom was fought over the Corn Laws of 1815, 1822, and 1828, and by the National Anti-Corn Law League (founded 1839), in which the moving spirits were before all Richard Cobden and John Bright. It was partly as a measure of retaliation against the Leaguers that the landed interest supported Sir Robert Peel in the removal or reduction of import duties on a large number of materials and manufactures in 1842 and 1845, but the effect was to strengthen the case for free-trade in grain very actively pressed by the League all over the country. In 1846 the fear of famine finally broke the resistance of the landlords to the repeal of the Corn Laws. The repeal of the Navigation Laws followed in 1849, and the last protective duties were removed by Gladstone in 1853 and 1860. Britain remained until 1914 the chief centre of free-trade, but the doctrine did not remain unchallenged. In 1881 the Fair Trade League was founded to advocate the

limitation of freedom of trade to those countries which would apply it reciprocally; later, in 1903, the Tariff Reform League was founded by Joseph Chamberlain. The first breach in Britain's seventy years' fidelity to free-trade was made in 1915, on the plea of discouraging 'luxury' imports during the European War. At the end of 1920 the Dyestuffs (Import Regulation) Act was passed, prohibiting for ten years, except under licence from the Board of Trade, the import of synthetic organic dyestuffs and intermediate products used in their manufacture. In 1921 the Safeguarding of Industries Act was passed, under which all articles belonging to industries scheduled as 'key' industries are subjected to a duty of 33½ per cent (imports from the empire being exempted) for five years from 1st Oct., 1921.

Broadly, it may be said that a large State can afford to choose what commercial policy it will follow; thus, with inter-State free-trade over an area comparable with the whole of Western Europe, the United States can afford a protective policy in regard to external commerce. But small States dependent on external commerce, as are the European neutrals, Belgium and Holland, Norway and Denmark, are bound to follow a free-trade policy. Even here the gain is a negative one, viz. the removal of an obstacle. Professor Gide writes (*Political Economy*, English edition, 1914, p. 350): "It is our opinion that the industrial prosperity of a country depends on other causes; that the customs system is one of the smallest factors in this, and that its importance has been singularly exaggerated". He points to the success both of America under protection and England under free-trade, and to the fact that the trade of protectionist Germany and free-trade Belgium has increased in about the same proportion.—BIBLIOGRAPHY: Adam Smith, *The Wealth of Nations*; Bastiat, *Economic Sophisms*; Mongredien, *History of the Free Trade Movement in England*; Morley, *Life of Richard Cobden*; C. F. Bastable, *The Theory of International Trade*; W. Smart, *The Return to Protection*; J. M. Robertson, *Free Trade*; J. H. Higginson, *Tariffs at Work*.

Free-will is the power possessed by man to choose freely between two contradictory actions without being forced by any external agency or by necessity to do so. It is the faculty of man to decide in the last resort between two opposing possibilities, in spite of pressure of exterior environment, and in spite of the internal contention of different motives. Man being conscious of this power, the partisans of the theory of free-will argue that as we *feel*, so we *know* that we are masters of ourselves, and that the power to decide must necessarily be inherent in us. The theory of free-will thus supposes that man pos-

sesses genuine moral freedom, is able to determine the course of his thoughts and volitions, and to decide which motives shall prevail in his mind. His decisions are determined neither by external nor internal compulsion, and are exempt from the principle of causation. For the human will can only be called really free if it is neither the result of an outside power nor the effect of man's own nature or environment. This free volition is due to man's self not entirely accounted for by character, motives, and circumstances. Moreover, the decision resulting from a really free-will cannot be foreseen or explained by anything except the will of man. The volition must therefore be somewhat spontaneous, that is, no one is able to predict with precision and infallibility the possible decision to which a man may arrive; otherwise it would follow that the act of volition has been determined by causes independent of the free-will of man. The opponents of the theory of free-will are called determinists, and the partisans of free-will may consequently be defined as indeterminists. The question of free-will ramifies into metaphysics, psychology, ethics, and theology, and is one of the few most important philosophical problems of all times. Alfred Fouillée rightly said that free-will or determinism is the philosophical question *par excellence*, and indeed all the questions dealing with human efforts and human duties must at one time or another take this problem into consideration. The whole fabric of legislature, of criminology and penology, is differently affected, according to whether free-will is admitted or denied.

Since time immemorial man believed that he possessed a certain power to determine his actions. Vaguely he felt this power, but he only began to speculate on this question later on. To the ancient Greek philosophers the problem of free-will did not as yet present itself very clearly. The Eleatics, Socrates, Plato, and Aristotle did not yet discuss the problem in a way in which it is looked upon by modern philosophers. The Stoics were determinists, i.e. opponents of the theory of free-will, whilst Epicurus advocated the idea of free-will or indeterminism. It was, however, with the advent of Christianity that the problem of free-will assumed a new aspect. The Schoolmen invented the term of *liberum arbitrium* and discussed its extent and limits. Whilst the pagan philosophers, interested in the problem, paid particular attention to the contradiction which existed between human independence and the continuous chain of causes, called by the Greeks *εἰσπραμένη* and by the Latins *fatum* (fate or destiny), Christianity was above all preoccupied with the contradiction existing between human free volition and divine omnipotence. Whilst

again the Greek and Roman philosophers, the Fathers of the Church, the Schoolmen, and the Scholars of the Reformation based their arguments upon reason, modern philosophers and psychologists argue from the point of view of experimental psychology. On the one hand, it must be admitted that if the word morality is to have any meaning at all, man must be free and responsible for his acts; duty, obligation, remorse, and responsibility would otherwise become empty words. If man's actions are determined by an external force, acting independently of him, he cannot be held responsible for his actions. On the other hand, psychology teaches us that mental life is made up of a series of mental phenomena. Every state of mind stands in relation to some other phenomenon; in other words, the phenomena of inner life, like those of external nature, are explained by the law of cause and effect. A man is moved to act by certain motives, but these motives themselves are the result of certain external influences as modified by character, which, in its turn, is the result of previous acts, either of the individual or of his ancestors. The vexed question of free-will is still a subject of controversy and a problem of the keenest interest. The rapid growth, however, of the sciences of physics, sociology, and biology, and especially of the theory of evolution which looks upon man as a mere link in the chain of causal development, tends to prove that the idea of free-will is a mere illusion.—BIBLIOGRAPHY: D. Stewart, *Moral Philosophy*; W. James, *Principles of Psychology*, and *The Will to Believe*; A. Bain, *The Emotions and the Will*; Ladd, *Psychology, Descriptive and Explanatory*; J. Ward, *The Realm of Ends*; H. Bergson, *Time and Free Will*; Renouvier, *Les Dilemmes de la métaphysique pure*; E. Boutroux, *La Contingence des lois de la nature*.

Freezing, or Solidification, the changing of a liquid into a solid. Substances which are crystalline when solid undergo the change from the liquid state at a definite temperature, called the freezing-point. Other substances, such as wax, have no unique temperature of solidification, but gradually become solid while cooling through a certain range of temperature. While solidifying, a substance undergoes a change of volume, and gives out latent heat. For crystalline bodies, the temperature of solidification of the liquid is the same as the melting-point of the solid, and methods of determining this temperature are described under art. *Melting-point*. The range of freezing-point temperatures is very wide, varying from that of helium, below -270°C. , to tungsten, which melts about 2800°C. ; carbon is supposed to melt about 4000°C. A knowledge of these freezing- or melting-points is very useful in thermometry, and when testing a thermometer

of wide range a series of bodies is chosen for which the melting-points are known. (See *Thermometer*.)

Change of Volume.—In most cases the change from liquid to solid is accompanied by a diminution of volume, but metals from which castings can be made, such as brass and steel, and a number of substances of which water is the most notable, increase in bulk as they become solid. The change in the case of water is almost 9 per cent, so that ice is less dense than water, and an iceberg in sea-water floats with about one-tenth of its volume above the water surface.

Effect of Pressure.—When pressure is applied to a substance, it affects the temperature of solidification. If a substance contracts on solidifying, an increase of pressure raises the freezing-point. The freezing-point of water is lowered 1.13°C . by a pressure of 1 ton per square inch, or a pressure of 135 atmospheres is required to freeze water at -1°C . Water has been kept in the liquid state at -20°C . by applying a pressure of 13,000 atmospheres. When water fills a closed space while subjected to a temperature below zero, it exerts a great pressure on the containing walls; this is the cause of the bursting of water-pipes during severe frost. When the temperature of snow is near the melting-point, a snowball may be formed by the pressure of the hands, but if the snow is considerably below zero, it does not cohere readily. The icy track sometimes made when a loaded cart passes over a snow-covered road is caused by the melting of the snow by pressure and its subsequent freezing into a film of ice when the pressure is released. For the same reason a weighted loop of wire hung on a block of ice slowly cuts through the ice but leaves the block solid at the finish. This effect is a contributing factor in the motion of glaciers, the ice melting where there is much pressure. (See *Glaciers*.)

Supercooled Liquids.—Water and other liquids may be cooled below their normal freezing-points without freezing if all air is removed and vibration is prevented. When a crystalline particle is dropped into the supercooled liquid, the latter suddenly freezes with evolution of latent heat and rise of temperature to the normal freezing-point. Water has been kept in capillary tubes at -20°C . without freezing.

Effect of Solution.—Water which contains a dissolved salt freezes at a lower temperature than pure water; sea-water freezes at -4°C . The greater the amount of salt dissolved, the more is the freezing-point lowered. If a number of grammes of a substance be taken equal to the number which specifies the molecular weight of the substance, the amount thus measured is termed a gramme-molecule. It is remarkable that if a gramme-molecule of any non-electrolytic

substance is dissolved in a large mass of liquid, the lowering of the freezing-point of the liquid is the same, whatever the substance. If, from the lowering observed in a dilute solution, the depression of the freezing-point is calculated which would be caused by dissolving one gramme-molecule in a hundred grammes of the solvent, we obtain the molecular depression of the freezing-point or the cryoscopic constant of the liquid; for water the value is 1.86 .

Cryohydrates.—When a weak solution of a salt in water is gradually cooled, pure ice is formed and the solution becomes stronger; finally the saturated solution freezes into a solid called a cryohydrate. The stronger the solution to begin with, the lower is the temperature at which ice begins to form.

Freezing Mixtures.—As a general rule, solids when dissolved in water cause a fall of temperature. This is the case with common salt, and when snow is substituted for water, the salt dissolves to form a liquid and there is a marked fall of temperature. Freezing mixtures are made by mixing together two or more substances which form a solution at a temperature below zero. If equal weights of salt and snow are mixed together, a liquid is formed which has a temperature of about -20°C .; when four parts of calcium chloride are mixed with three parts of snow, the liquid formed falls to about -50°C . Such mixtures are employed to obtain low temperatures for laboratory experiments.

Freezing Machines.—The principle employed in the Carré ammonia apparatus is the production of cold by evaporation. (See *Evaporation*.) Ammonia gas is freed, by heat, from a strong aqueous solution of ammonia, and led to a closed vessel containing another vessel with the water to be frozen, where it is condensed. When, after cooling, the liquid ammonia is evaporated, the gas abstracts latent heat from the water which is thus frozen. Much greater cold can be produced by the evaporation of liquid air. (See *Liquefaction of Gases*; *Vaporization*.)

Solidification of Gases.—Oxygen, nitrogen, and hydrogen, once known as permanent gases, have been solidified from their liquids. By rapidly evaporating a mass of liquid air, Dewar obtained about a pint of solid air. Nitrogen, hydrogen, and helium have also been solidified by a similar cooling process, though with greater difficulty.—BIBLIOGRAPHY: C. H. Draper, *Heat*; W. C. D. Whetham, *Solution and Electrolysis*; Kaye and Laby, *Physical Tables*.

Freiberg (fri'berh), a German mining town, the centre of the mining district of Saxony, 20 miles w.s.w. of Dresden, near the Mulde. There are still remains of its former walls, towers, and ditches, but their site has mostly been converted into a promenade. The principal buildings

and establishments are the cathedral, the mining academy with a museum attached, the town house, the castle (now a military magazine), and the silver refinery. The Freiberg district yields silver, copper, lead, and cobalt. Pop. 36,237.

Freiburg (fri'byrſ), or **Freiburg im Breisgau**, a town of Baden, on the Dreisam, 42 miles s.s.e. of Strasbourg. It consists of the town proper, still possessing some remains of fortifications, and of large suburbs. The chief buildings are the cathedral, a large and beautiful Gothic structure, with a fine portal richly sculptured, and surmounted by a tower with a spire of exquisite open work 380 feet high; the Ludwigskirche; the university, founded in 1456; the museum, and theatre. The manufactures are numerous, but not individually of great extent. Pop. (with suburbs), 83,324.

Freight, the sum paid by a merchant or other person hiring a ship or part of a ship, for the use of such ship or part during a specified voyage, or for a specified time; also any sum charged for the transportation of goods.

Freiligrath (fri'lih-rät), Ferdinand, German lyric poet, born at Detmold 1810, died at Cannstadt, in Württemberg, 1876. In 1838 he published at Mainz a volume of his collected poems, which proved successful and gained him a pension, which he relinquished on the publication of his *Glaubensbekenntnis* (Confession of Faith), the republican character of which caused his prosecution and flight to London. He returned to Germany in 1848 and took part in the revolutionary movements, publishing the political poems *Die Revolution*, *Februarklänge*, and *Die Todten an die Lebenden*. The last of these led to his being put on trial for treason. This trial, in which he was acquitted, is memorable for another reason, being the first jury trial ever held in Prussia. From 1851 till 1867 Freiligrath again resided in England, but his last years were spent at Cannstadt. Many of his songs, such as *Hurrah! Germania*, in which he celebrated Germany's triumph in 1870, are still very popular. Germany is indebted to him for many admirable translations from foreign languages, as those of portions of Burns, Tannahill, Moore, Hemans, Shakespeare, Longfellow, and Victor Hugo.

Freising (fri'zing), a town of Bavaria, on the left bank of the Isar, 21 miles n.n.e. of Munich. It has a fine old cathedral church. Pop. 14,946.

Freistadt (fri'stät-l), a town of Czecho-Slovakia, formerly in Hungary, on the Waag, with a large trade in cattle. Pop. 9000.

Fréjus (frä-zhüs; ancient *Forum Julii*), a town, France, department of Var, on the Mediterranean, 45 miles n.e. of Toulon. Among its Roman antiquities are the remains of a port,

quays, and lighthouse, a triumphal arch, an amphitheatre, and aqueduct. Pop. 4000.

Fremantle, Hon. Sir Edmund Robert, g.c.n., British admiral, born in London in 1836. He entered the navy in 1849, and saw service in the Burmese War of 1852, in New Zealand in 1864-6, and in the Ashanti War in 1873-4. He became a rear-admiral in 1885, was commander of the Channel Squadron in 1886, commander-in-chief in the East Indies from 1888 to 1891, in China from 1892 to 1895, and at Plymouth from 1896 to 1899. He was knighted in 1889, and retired with the rank of admiral. He published an *Essay on Naval Tactics* (1880), and *The Navy as I have known it* (1905).

Fremantle, the chief seaport of Western Australia, at the mouth of the Swan River, 12 miles from Perth, with which there is communication both by rail and river-steamer. There are several fine buildings, including the town hall, court-house, and the Episcopal and Roman Catholic churches. The river is crossed by a long wooden bridge. The unsatisfactory harbour accommodation has been improved by blasting and the construction of moles. The manufactures include aerated waters, boots, soap, furniture, and confectionery. Pop. 21,670.

Frémont, John Charles, American explorer, born at Savannah, Georgia, 1813, died in 1890. He conducted five separate and adventurous expeditions which explored the passes of the Rocky Mountains, and practically opened up the great far west. He took an active part in the conquest of Upper California, and served in the Civil War. Afterwards he became a lawyer and an active promoter of railroads.

Fremont, an American city, capital of Sandusky County, Ohio. It has a considerable trade, lines of steamers running from the city, which stands at the head of steam navigation on the River Sandusky, to the principal ports of Lake Erie. Pop. 9940.

French, John Denton Pinkstone, Earl French of Ypres, o.m., k.p., g.c.b., g.c.v.o., &c., British soldier, born at Ripple, Kent, in 1852. After four years in the navy he entered the 8th Hussars in 1874, and served in the Sudan campaign of 1884-5 with the 19th Hussars, which regiment he commanded from 1889 to 1893. He held staff and other appointments from the latter year until 1899, when he was gazetted as major-general to command the cavalry division in Natal. He commanded the troops at Elandslaagte in that year, left Ladysmith in the last train to get through before the investment, and was then appointed lieutenant-general commanding the cavalry division in South Africa. At the end of 1899 he commanded in some very successful operations at Colesberg, and subsequently relieved Kimberley (Feb., 1900), his cavalry also

contributing much to the success of Lord Roberts's further operations in the advance to Bloemfontein and Pretoria and afterwards. He was frequently mentioned in dispatches. In 1901 he was appointed to the command of the First Army Corps at Aldershot, and became Inspector-General of the Forces in 1907. In 1913 he was made field-marshal, but resigned in March, 1914, in consequence of a controversy between the army and the Cabinet over the service of the army in Ulster. At the outbreak of the European War he re-entered the army and commanded the Expeditionary Force in France, and fought the battles of Mons (Aug., 1914) and of Ypres (19th Oct. to 21st Nov., 1914). In Dec., 1915, French was succeeded by Haig, whilst he himself took command of the home forces, and was raised to the peerage as Viscount French of Ypres and High Lake, Roscommon. In 1918 he was appointed Viceroy of Ireland. In 1919 he published his account of the First Expeditionary Force under the title *1914*. He was succeeded in the Lord-Lieutenancy of Ireland by Viscount Fitzalan, and was created an Earl in 1921. He died in 1925.

French Beans, or **Kidney-beans**, the *haricots* of the French, are the products of the *Phaseolus vulgaris*, supposed to be a native of the East Indies, but now commonly cultivated in all parts of the globe. This plant is a twining annual, bearing alternate leaves, on footstalks, composed of three oval pubescent folioles. The flowers are whitish, somewhat resembling those of the pea. The seeds are more or less kidney-shaped. A great number of varieties are cultivated, among which is that commonly called *Lima bean*. They are eaten prepared in various manners.

French Berries, known also as *Avignon Berries* and *Yellow Berries*, the fruit of the *Rhamnus Clusii*, or other species of buckthorn, rather less than a pea, have a bitter and astringent taste, and are used by dyers and painters as a yellow colouring-matter.

French Chalk, scaly tale, a massive variety of tale, composed of small scales of a pearly-white or greyish colour: much used by tailors for drawing lines on cloth, and for similar purposes.

French Congo, or **French Equatorial Africa**, a territory in Africa. It is bounded by the Anglo-Egyptian Sudan (Bah-el-Ghazal) on the east, the Cameroons on the west, and the Belgian Congo on the south, stretching inland from the sea to Lake Chad; area, about 672,000 sq. miles; pop. 9,000,000. In 1910 the French Congo was divided into three circumscriptions, namely, the Gabon Colony, the Middle Congo Colony, and the Ubangi Shari Colony. The name was changed into French Equatorial Africa. In 1911 France ceded to Germany certain parts of

the colony, which are now again French. The chief rivers are the Gabun, Ogowe, and Kwilu, and the stations already founded include Libreville (the capital), Brazzaville, Njola, Philippeville, Loango, and Franceville. Both the coast, which is malaria-infected, and the higher plateaus are unhealthy for Europeans, but a considerable trade is carried on, the exports comprising caoutchouc, cocoa, coffee, ivory, ebony, mahogany, palm-oil, gum-copal, &c. The gorilla and chimpanzee are native in the Ogowe region, and there are pygmies in the Equatorial forest.

French Honeysuckle (*Hedysarum coronarium*), the inappropriate name of a leguminous plant, a common perennial in gardens, where it is grown for the sake of its beautiful scarlet flowers. In Sicily and Spain it is largely cultivated as a green crop, yielding an enormous quantity of herbage.

French Language and Literature. See *France*.

French Polish, a solution of shell-lac in alcohol, used for giving a smooth surface-coating to furniture and cabinet-work. The most common of the varnishes known under the name of French polish are prepared as follows: pale shell-lac, 5½ ounces; finest wood-naphtha, 1 pint; dissolve. Or pale shell-lac, 3 lb.; wood-naphtha, 1 gallon. Methylated spirit (68 o.p.) may be substituted for the naphtha in the above formula. These varnishes are sometimes coloured to modify the character of the wood. A reddish tinge is imparted by dragon's-blood or red sandalwood, and a yellowish tinge by gamboge or turmeric-root.

French Revolution. See *France*.

French River, a Canadian river, which flows from Lake Nipissing into Georgian Bay, Lake Huron; length, 55 miles.

French West Africa, a vast region belonging to France, and comprising Senegal, Upper Senegal and the Niger, French Guinea, the Ivory Coast, the Upper Volta Colony, the territory of Mauritania, and Dahomey. It extends from the Atlantic to Lake Chad, where it meets the hinterland of the French Congo. The limits of French influence have been partly defined by conventions arranged with Great Britain in 1890, 1898, 1904, and 1906. The delineation of the boundary was completed in 1912, and approved by the French and British Governments in 1914. The whole is under a Governor-General, whose seat is the rising port of Dakar, connected by railway with St. Louis. In the interior are Kayes, Bafoulabé, and Bamakou (connected by a railway), Timbuctoo, and Jenné. Area, about 1,745,000 sq. miles; pop. 12,206,889. See separate articles on the various colonies, and *Togoland*.

Frere, Sir Henry Bartle Edward, statesman

and administrator, born at Clydale, Wales, 1815, died at Wimbledon 1884. He entered the East India Company's civil service in 1833; mastered the native languages with great rapidity, and introduced important improvements into the system of tax collection. From 1847 to 1850 he was Resident at Sattara, and at the latter date succeeded Sir Charles Napier as Chief Commissioner at Scinde. He rendered valuable services during the Mutiny, at the close of which he was nominated to the Viceroy's Council at Calcutta. He returned to England in 1867. In 1872 he negotiated a treaty with the Sultan of Zanzibar, abolishing the slave-trade in that ruler's dominions. In 1877 he went to South Africa as Commissioner for the settlement of native affairs, but this mission was a failure. He was the author of a life of his uncle, John Hookham Frere, and numerous lectures and pamphlets.—Cf. John Martineau, *Life and Correspondence of Sir Bartle Frere*.

Frere, John Hookham, born in London 1769, died at Malta 1846. He is now chiefly remembered as one of the writers in the *Anti-Jacobin Review* at the close of the eighteenth century; and afterwards connected with the establishment of the *Quarterly Review* in 1809. A satirical poem published by him in 1817, entitled *Prospectus and Specimen of an Intended National Work, by William and Robert Whistlecraft*, followed by another entitled *The Monks and the Giants*, obtained in their day much popularity. His translations in verse of some of the comedies of Aristophanes are well-known for their remarkable excellence, though superseded by the much more scholarly and livelier version of Rogers. He entered Parliament in 1796, and succeeded Canning as Under-Secretary for Foreign Affairs in 1799. From 1818 to 1819 he acted as British Ambassador in Spain, and subsequently held other diplomatic posts in Portugal and Prussia. The latter years of his life were spent in Malta.—Cf. Gabrielle Festing, *J. H. Frere and his Friends*.

Fréron (frä-rôn), Élie Catherine, French journalist, born at Quimper 1719, died at Paris 1776. In 1746 he commenced a periodical entitled *Lettres de Madame la Comtesse de —*; this, with various interruptions and change of name, was continued till his death. He may be called the founder of newspaper criticism in France; and had a life-long conflict with the Encyclopédists and Voltaire, who parodied Fréron's *L'Année littéraire* as *L'Âne littéraire* in his comedy *L'Écossaise*.

Fresco Painting, a method of mural painting in water-colours on wet and caustic grounds of lime. Mineral or earth pigments are employed, which resist the chemical action of lime. In drying, as the plaster absorbs carbonic acid

from the air and hardens, the colours are incorporated with the plaster, and are thereby rendered as permanent as itself. In producing fresco paintings, a finished drawing on paper, called a cartoon, exactly the size of the intended picture, is first made, to serve as a model. The artist then has a limited portion of the wall covered with plaster, and upon this he traces from his cartoon the part of the design intended for the space. As it is necessary to the success and permanency of his work that the colours should be applied while the plaster is damp, no more of the surface is plastered at one time than what the artist can finish in one day. A portion of the picture once begun, needs to be completely finished before leaving it, as fresco does not admit of retouching after the plaster has become dry. On completing a day's work, any unpainted part of the plaster is removed, cutting it neatly along the outline of a figure or other definite form, so that the joining of the plaster for the next day's work may be concealed. The art is very ancient, remains of it being found in Crete, Egypt, India, Greece, and Mexico. Examples of Roman frescoes are found in Pompeii and elsewhere. After the beginning of the fifteenth century fresco painting became the principal process used by the greatest Italian masters, until it was displaced by the use of oil paint; an intermediate stage being the use of oil or tempera on a fresco foundation. *Fresco Secco* is distinguished from true or *buon fresco* by being executed on dry plaster, which is moistened with lime-water before the colours are applied. In *spirit fresco* a wax and varnish medium is used to apply colour to a dry plaster ground. Fresco painting has in recent years again been revived, and works of this kind have been executed in the British Houses of Parliament and other public and private buildings, especially in Germany.

Freshfield, Douglas William, English traveller, was born in 1845, and was educated at Eton and at University College, Oxford, where he graduated in 1867. He was called to the Bar in 1870, but devoted himself mainly to travel, having visited and explored Syria, the Caucasus, Armenia, Algeria, Corsica, and the Alpine and Himalaya regions. He published the following interesting and readable accounts of his journeys: *Travels in the Central Caucasus and Bashan* (1869), *The Italian Alps* (1875), *Climbs in the Caucasus* (1888), *The Forests of Abkhazia* (1890), *The Exploration of the Caucasus* (1896), *Round Kangchenjunga* (1904), and *Hannibal once more* (1914). He was editor of the *Alpine Journal* from 1872 till 1880, and president of the Alpine Club from 1893 till 1895, besides being for a long time one of the honorary secretaries of the Royal Geographical Society.

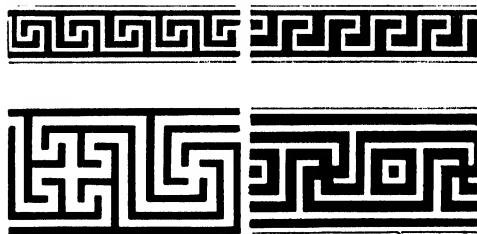
Fresh-water Strata, in geology, strata formed by the deposition of mud or sand in lakes or rivers, or by fresh water filtering into caverns, the character of the strata being determined by an examination of the contained fossils. They are generally more limited in area than those deposited by the sea.

Fresnel (frā-nel), Augustin Jean, French physicist, born 1788, died 1827. He did more perhaps than any other man to establish the undulatory theory of light, elucidated the phenomena of interference, diffraction, and polarization, and greatly improved the illuminating apparatus of lighthouses. See his biography by Arago in volume 1 of his complete works, published by the French Government, 1866-70; also E. T. Whittaker, *History of the Theories of Æther and Electricity*.

Fresnillo (-nil'yō), a city, Mexico, state of and 30 miles N.N.W. of Zacatecas. In its vicinity are celebrated silver- and copper-mines. Pop. 15,150.

Fresno, a town of the United States, in California, in a great irrigation district, with important fruit, corn, and wine industries. Pop. 24,892.

Fret, a kind of ornament much employed in Grecian art and with some modifications



Grecian Frets

common in various other styles. It is formed of bands or fillets variously combined, but most frequently consists of continuous lines arranged in rectangular forms. Sometimes called *Key Ornament*.

Frets, certain short wood, ivory, or metal cross-bars on the finger-boards of stringed instruments, as the guitar, which regulate the pitch of the notes. By pressing the string down to the finger-board behind a fret only so much of the string can be set in vibration as lies between the fret and the bridge.

Freud, Sigmund, Austrian physician and psychologist, born at Freiberg, Moravia, 6th May, 1856. He studied at Vienna and Paris under Charcot, and was appointed professor of neuropathology at Vienna in 1902. His contributions to science are a new method for the analysis and treatment of hysteria, called psycho-analysis, and

a theory of dreams. Dreams, according to Freud, represent the gratification of suppressed wishes in a disguised manner. It must, however, be observed that the method of psychological investigation to which Freud gave the name of psycho-analysis was already discussed by Max Nordau in his *Entartung* (Degeneration, 1893). His works include: *Papers on Hysteria* (1895), *Interpretation of Dreams* (1913), *Delusion and Dream* (1917), *Psychopathology of Everyday Life* (1901 and 1914), *Three Contributions to the Theory of Sex* (1905 and 1918), *Totem and Taboo* (1913 and 1919). See *Psycho-analysis*.

Freya, in the northern mythology, the goddess of love, and wife of Odin; she was a friend of sweet song, and loved to hear the prayers of mortals. She had a famous necklace, much celebrated in Scandinavian legends. Freya is the sister of Frey and the daughter of Njörd, and often confounded with Frigg.

Freycinet (frā-si-nā), Charles Louis de Saulees de, French statesman, born at Foix (Ariège) 1828. He was trained as an engineer, and held several important appointments. Elected to the Senate in 1876, he was Minister of Public Works 1877; Minister for Foreign Affairs 1877-9. He was Premier four different times between 1879 and 1890, as also War Minister several times (last in 1898). He is the author of important works on engineering. His *Mémoires* appeared in 1914. He died in 1923.

Freytag (fri'tāh), Gustav, German poet, dramatist, and novelist, born 1816, died in 1895. He was editor of the *Leipzig Grenzboten* from 1848 to 1870, and produced numerous successful plays, tales, and poems. Among his more famous works are: *Soll und Haben*, *Bilder aus der Deutschen Vergangenheit*, *Die Verlorene Handschrift*, and *Die Ahnen*, a series of six romances illustrative of old German life.

Friar (Fr. *frère*, Lat. *frater*, brother), in the Roman Catholic Church an appellation common to the members of all religious orders, but more especially to those of the four mendicant orders, viz. (1) Minors, Grey Friars, or Franciscans; (2) Augustines; (3) Dominicans or Black Friars; (4) White Friars or Carmelites.

Friar's-balsam, an alcoholic solution of benzoin, styrax, tolu balsam, and aloes, used as an application for wounds and ulcers.

Fribourg, or **Freiburg** (frē-bōr, fri'burh), a canton of Switzerland, surrounded by the cantons of Berne and Vaud, except a narrow part, which touches the Lake of Neuchâtel. The southern part is mountainous, the northern part more level. The whole canton abounds in excellent pasturage, and cattle-breeding and dairy husbandry are the chief occupations of the inhabitants. Area, 644 sq. miles; pop. 144,000, of whom the great majority are Roman Catholics

speaking French. The canton sends seven representatives to the National Council.

Fribourg, the capital of the canton, is picturesquely situated on the Saane, 17 miles s.w. of Bern. It stands partly on a rocky eminence at the edge of a ravine nearly surrounded by the river, which is here spanned by a suspension bridge 168 feet above the water. The Gothic church of St. Nicholas contains one of the finest organs in Europe. Pop. 20,400.

Fricourt, a village of France, department of Somme, 5 miles east of Albert. It was captured by the Germans during the European War, and retaken by the Allies in Aug., 1918.

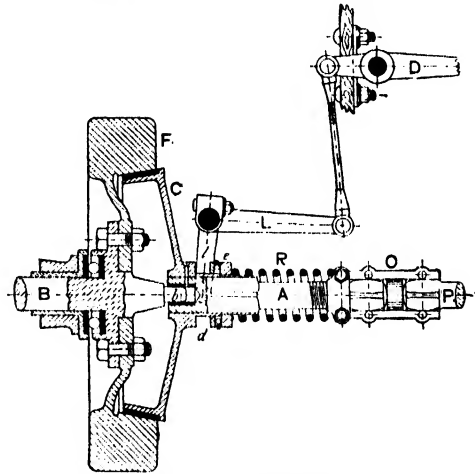
Friction, a force which is brought into play when one body moves or tends to move over another. It always acts as a resistance to motion; when it prevents motion, it is called static friction; when slipping takes place, it is known as kinetic friction. Static friction may have any value between zero and a maximum which is reached just before slipping takes place, and which is called limiting friction. When slipping begins, the friction force suddenly diminishes to a smaller value; it is a matter of common experience that a greater force is required to start a mass in motion against friction than is necessary to keep the mass moving. Friction is proportional to the normal or perpendicular pressure between the two surfaces in contact, and the ratio of the friction force to the normal pressure is called the coefficient of friction. Friction is independent of the area of the rubbing surfaces, and when motion takes place, the friction is independent of the speed of slipping, except for very low speeds. These laws assume that no change takes place in the surfaces as the result of rubbing—a condition which is never realized. Friction may be diminished by smoothing the surfaces, by the use of rollers, wheels, or ball-bearings, and by applying lubricants such as oil, graphite, &c. Friction is the ultimate force employed in stopping vehicles by means of brakes. It is by means of friction we are able to hold objects in our hands, and to walk on the ground. Friction always produces heat, and, when the surfaces are unlike, it also generates electricity. The particles of a fluid exert friction against each other, and against any solids in contact with them.

Friction Clutch or Coupling, a device by which a constantly rotating shaft gradually communicates its motion, without shock, to a driven part. The illustration shows such a clutch arranged for a motor-car.

Friction-wheels, in machinery, two simple wheels or cylinders intended to assist in diminishing the friction of a horizontal axis. The wheels are simply plain cylinders carried on parallel and independent axes. They are disposed so

as to overlap pair and pair at each end of the main axis, which rests in the angles thus formed by the circumferences. The axis, instead of sliding on a fixed surface, as in ordinary cases, carries round the circumferences of the wheels on which it is supported with the same velocity as it possesses itself, and in consequence the friction of the system is proportionally lessened.

Friday, the sixth day of the week, from the A.Sax. *Frige-dæg*, the day sacred to *Frigga*, the Norse goddess of love. It is the day of



Motor-car Conical Clutch

D, The pedal lever. L, Bell-crank lever. B, Reduced end of the engine-shaft. R, Clutch-spring which is compressed by depressing the lever D, and so disengages the clutch C from frictional contact with fly-wheel F; on release of D the spring R moves C back to its working position. d, Collar by pressure on which the fork f withdraws the clutch C. e, Ball-bearing to take thrust of L. A, Clutch-shaft, connected with primary shaft P by split-coupling O.

religious gatherings among Mohammedans. See *Good Friday*.

Friedland (frěd'lant), (1) a town of Northern Bohemia, Czecho-Slovakia. Wallenstein was created Duke of Friedland in 1622. Pop. 6260. (2) A small town of East Prussia, 28 miles s.e. of Königsberg, on the River Alle. Pop. 2850. The Russians under Benningsen were here defeated on the 14th June, 1807, by the French under Napoleon. (3) A town of Mecklenburg-Strelitz, 30 miles n.e. of Strelitz. Pop. 7240.

Friedrichroda, a German town, in the former Duchy of Gotha, charmingly situated in the valley of the Schilfswasser, a favourite health and summer resort. Pop. 4400.

Friendly Islands, or **Tonga Islands**, a cluster in the South Pacific Ocean, between lat. 15° and 23° s., and long. 173° and 177° w.

They consist of three groups, Tongatabu, Hapai, and Vavau, which are divided from each other by two narrow channels, and number altogether about 150, with a collective area of about 385 sq. miles. The largest island is Tongatabu, in the south group, which contains the capital, Nukualofa. Vavau, in the north group, which is named after it, is next Tongatabu in size; the centre group is called Hapai. The islands are nearly all volcanic, with coral reefs and rocks about them; earthquakes and volcanic eruptions are frequent, during one of which, in Oct., 1885, a new island 2 miles in circumference suddenly appeared. These islands were discovered in 1643 by Tasman, but received their collective name from Cook. They are governed by a native Christian prince under British protection. In April, 1918, the native King George II was succeeded by his daughter Salote. The trade is considerable, the chief exports being copra and fruit. Pop. about 23,766 (1917).

Friendly Societies, societies formed for the mutual advantage of the members, and based on the principle that it is by the contribution of the savings of many persons to one common fund that the most effectual provision can be made for casualties affecting, or liable to affect, all the contributors. Mutual provident associations, taking the friendly society form, may be grouped under five main heads: (1) Affiliated Societies; (2) Ordinary Societies, subdivided into (a) Centralized or General Societies, (b) Peculiar Trade and Profession Societies, (c) Local, including Dividing, Clubs, (d) Societies of Women; (3) Collecting Societies; (4) Medical Societies; and (5) Other Societies registered under the Friendly Societies Act, including (a) Cattle Insurance Societies, (b) Benevolent Societies, (c) Working Men's Clubs, and (d) Specially Authorized Societies, i.e. those existing for purposes to which the Treasury specially extends any of the provisions of the Act. Divisions (1) and (2) offer a sickness as well as a funeral benefit to their members, and some of them offer a deferred annuity or superannuation as an optional benefit in addition. Each registered society or branch must have a registered office, and each society must send annually to the Registrar of Friendly Societies a return of income and expenditure, and assets as audited. Every five years the financial condition of societies is inquired into and a report made by a valuer. The funds are guarded against maladministration or fraud, and facilities for the prosecution of the offender or offenders given. The Friendly Societies Act of 1896 consolidated the law on the subject, and was supplemented in some ways by the Collecting Societies and Industrial Assurance Companies Act of the same year. The following figures of membership and funds in the year 1918 are

taken from the annual report of the Chief Registrar of Friendly Societies:—

	Members.	Funds.
1. Affiliated Societies ..	2,928,186	£33,017,726
2. Ordinary Societies ..	3,763,369	£28,810,212
3. Collecting Societies ..	9,726,216	£14,839,173
4. Medical Societies ..	130,189	£78,129
5. Other Societies ..	820,607	£3,526,687

Mutual provident association, on the voluntary principle and in a friendly society form, as an economic duty, is at present characteristic mainly of the English-speaking races. The affiliated societies (or orders, as they are called) extend their operations beyond the confines of the United Kingdom to America and the British colonies and dependencies. These societies are fraternities or brotherhoods, occupying in part the position of the old craft guilds. The Independent Order of Oddfellows (Manchester Unity) and the Ancient Order of Foresters far outstrip all the other orders in numerical and financial strength, the former possessing in 1918 a membership of 778,528, and in its lodges a capital of £14,914,295, whilst the latter had in the same year 601,080 members, and funds to the sum of over £9,326,710 in its branches, or courts as they are termed. The amount of relief work done by these societies may be estimated from the fact that during 1918 the Manchester Unity paid out £760,267 in sickness benefit and £297,680 in funeral benefit, while the A.O.F. paid out £530,353 and £231,879 respectively. The Loyal Order of Ancient Shepherds (Ashton Unity) is another powerful fraternity, being particularly strong in Scotland; other orders are known as Druids, Rechabites, Free Gardeners, Sons of Temperance, Romans, Locomotive Steam Enginemen and Firemen's Friendly Society, &c. The Independent Order of Rechabites and the Order of Sons of Temperance exhibit the economic phase of the temperance movement, and the former especially has increased very rapidly in recent years. The Locomotive Steam Enginemen, &c., is confined to railway employees, and is the only peculiar trade society which is constituted as an order. In this group, as a rule, the constitution and government are purely democratic, consisting of individual branches (called lodges, courts, tents, senater, &c.), local gatherings of branches (generally called districts), and a central executive elected from annual or biennial parliaments of branch delegates.

The general group consists of bodies with one central office and a scattered area of membership up and down the country, as the Hearts of Oak, the Rational Sick and Burial Association, and the United Patriots; or of bodies known as county societies, because the membership of each society is restricted to the geographical area of some one county—generally of the

east and south of England. Before it became a collecting society the Hearts of Oak was by far the largest of the general group. In the case of these bodies the funds are centralized, and not retained in districts and lodges (or courts), as is the case with the orders.

Among the societies connected with peculiar trades, the most important are those connected with mining. These are accident insurance organizations, the funds of which are subsidized by the employers as a contribution towards their liabilities in the case of fatal or non-fatal casualties to the workmen in their employ. By means of them the workmen were able to contract themselves out of the Employers' Liability Act of 1880 and the Workmen's Compensation Act of 1897. Membership is almost entirely confined to the coal-getting miners. Since the Workmen's Compensation Act of 1906 a contracting-out scheme, however, has to be registered.

Local benefit clubs have had their day, and are being displaced by branches of the affiliated orders. A large proportion of this division are tontine or dividing societies; i.e. temporary combinations on the mutual basis, which break up and divide their capital every twelvemonth or so, and then commence anew.

The collecting societies insure mainly for funeral benefit, but do pay other benefits. The larger members of the group have nearly swallowed up the smaller, and in Britain there are four societies of over 100,000 members, which comprise between them over 90 per cent of the members and funds. These societies are: Liverpool Victoria Legal, Royal Liver, the Hearts of Oak, and Scottish Legal, the membership of the first two exceeding 4 and 3 millions respectively, while the Hearts of Oak has nearly half a million members. As a rule, these societies are trading concerns chiefly for the benefit of the promoters and collectors, these latter calling from door to door for the weekly pence of the members, but this does not apply to the Hearts of Oak. There is only a technical difference between them and the industrial insurance companies, and as a result of the recommendations of the Industrial Insurance Committee which reported early in 1921, legislation is foreshadowed, whereby collecting societies will be required to make a deposit of the same amount as that required from insurance companies conducting life insurance business.

Separate societies used formerly to be established consisting wholly of 'juveniles', in connection with societies of the general group and branches of the affiliated orders, but in 1895 the necessity for such separate societies was done away with by an enactment that every society may have members of any age exceeding one

year. Societies of women, however, have now begun to play a very definite part in the voluntary thrift movement. Altogether the number of different bodies of one class or another registered as separate societies or branches, in Great Britain and Ireland, is about 30,000.

Though friendly societies exist mainly for the benefit of the 'masses', the friendly society form of mutual insurance is that under which some flourishing assurance societies, such as the Clergy Mutual, the National Provident, and the United Kingdom Temperance, were originally established; and we may instance as more recent examples of its adaptation to the 'classes', the establishment in London of a society of the general type for the benefit of the medical profession, the Medical Sickness and Annuity Friendly Society; and the Clergy Friendly Society, restricted to members of the Church of England.

The three prime necessities for securing financial stability and efficient government are: (1) Registration, (2) Valuation, (3) Graduation. This last requisite refers to the adoption of a graduated scale of annual contribution according to age on joining.

Friendly societies exist also in the colonies and in foreign countries. In the several Australasian colonies more than £3,000,000 has been accumulated by these societies. In France a distinction is drawn between societies that are simply authorized and those that are approved, and these latter enjoy many privileges, which amount to a considerable State subsidy. In Belgium, also, a distinction is made between recognized and non-recognized societies. In Holland half the population are insured in some sickness benefit society. In Spain the history of these societies may be traced back to the mediæval guilds. See also *Building Societies; Co-operative Societies.*—BIBLIOGRAPHY: J. F. Wilkinson, *The Friendly Society Movement*; Fuller, *The Law relating to Friendly Societies*; A. C. Stevens, *The Cyclopædia of Fraternities*; *Annual Reports of the Chief Registrar of Friendly Societies.*

Friends, Society of, commonly known as Quakers, a society of Christians which took its rise in England about the middle of the seventeenth century. George Fox, a native of Drayton, in Leicestershire, was the first to teach the religious views which distinguish the society. He commenced his ministerial labours in 1647, and immediately fell under persecution. But persecution, as usual, enlisted the sympathies of many in his cause. After making multitudes of converts he organized them into a Church, which became, although not until after severe persecution, one of the recognized sects of Christianity. Among the other eminent mem-

bers of the society in its early days we may mention William Penn, Robert Barclay, George Whitehead, Stephen Crisp, Isaac Pennington, John Crook, Thomas Story, &c. The early Quakers were marked as a peculiar people by their testimonies against oaths, a paid ministry, and tithes; their use of the singular pronouns when addressing only one person; their refusal to take off the hat as a compliment to men; the plainness of their apparel; and their disuse of the ordinary names of the months and days. The name Quakers was given to them in derision, and though they accepted the name they call themselves by that of Friends. A Derby magistrate was the originator of the derisive epithet according to Fox himself—"because I bade him tremble at the word of God". The persecution and intolerance of which they were the victims, both in England and America, only tended to confirm the faith and strengthen the bond of union among the members of the rising society; and in neither country could it induce the sufferers to relinquish their conformity to what they regarded as duty. From the diffusion of more enlightened views on the subject of religious liberty, Acts were successively passed by the English Parliament, relieving Friends from the oppression under which they suffered, tolerating their mode of worship, marriage, &c., and allowing them in a court of justice to make an affirmation in place of taking an oath in the usual way. The same liberal policy was pursued in America. One of the brightest chapters in the annals of Quakerism is that relating to the founding of the colony of Pennsylvania. (See *Penn, William; Pennsylvania.*) But, as in other reforming sects, so among the Quakers, success in the course of time gradually undermined their zeal, and deprived them of many of their characteristic qualities. Gradually the spread of wealth modified the stringency of their 'sumptuary' rules, and there was in consequence a rapid decline of the ancient discipline. Coincident with these relaxations of rule arose disputes as to doctrine. About the year 1827 Elias Hicks, a native of the state of New York, created a schism in the society by promulgating opinions denying the miraculous conception, divinity, and atonement of Christ, and also the divine authority of the Scriptures. About half the sect in America followed Hicks, and have since been known as the Hicksite Friends. The schism made much stir among Quakers in Great Britain as well as in America, and a movement was begun in favour of higher education, and of a relaxation in the formality of the society. This movement, headed by Joseph John Gurney, of Norwich, was strenuously opposed by a body of Quakers in America, and the result was a division among the Orthodox Friends them-

selves, and the origin of a new sect, known as Wilburites, from John Wilbur, its founder.

The society, or the orthodox section of it, believes that, under the gospel dispensation, all wars and fightings are strictly forbidden; the positive injunction of Christ, 'Love your enemies', &c., entirely precluding the indulgence of those passions from which alone such contests can arise. They also believe that the express command, 'Swear not at all', prohibits the Christian from the use of judicial as well as other oaths. In like manner, following the spirit of the Scriptures, they believe that a special call is necessary to constitute a true minister of the gospel, that the faithful minister should not preach for a pecuniary reward, that the essential baptism is of the Holy Ghost, not by water, and that the Lord's Supper is also entirely of a spiritual nature. They therefore renounce both these sacraments so far as the ordinary outward forms are concerned. As to the cardinal doctrines of Christianity, the incarnation, crucifixion, resurrection, redemption through Christ's death, justification, &c., their beliefs are similar to those of orthodox Christians generally. The Quakers were one of the first sects to allow women to teach publicly. As early as 1727 they censured the traffic in slaves, and the efforts of the society had a great influence in bringing about their emancipation. They object to balls, gaming-places, horse-races, theatres, and music; also to the reading of plays, romances, and novels; and enjoin plainness of dress and the avoidance of ornaments.

The society is governed by its own code of discipline, which is enacted and supported by meetings of four degrees for discipline--namely, preparative, monthly, quarterly, and yearly meetings. The preparative digest and prepare the business for the monthly meetings, in which the executive power is principally lodged, subject, however, to the revision and control of the quarterly meetings, which are again subject to the supervision and direction of the yearly meetings. There are about 30,000 members and adherents in Britain, about 100,000 in the United States and Canada, besides small numbers in other countries. BIBLIOGRAPHY: George Fox, *Journal*; J. Besse, *The Sufferings of the Quakers*; T. E. Harvey, *The Rise of the Quakers*.

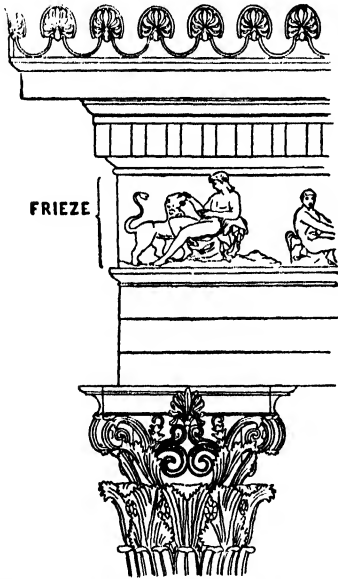
Friern Barnet, an urban district in North Middlesex, England, 3 miles south-east of Barnet, with an ancient church. The London County Lunatic Asylum is in the parish. Pop. 17,381.

Fries (frēs), Elias Magnus, Swedish botanist, born 1794, died 1878. In 1824 he was appointed professor of botany at the University of Lund, and in 1836 was transferred to that of Upsala. His botanical writings are very numerous, and cover the entire field of botany. He devised a

natural system of classification, based on morphology and biology, which differs in many respects from those of Jussieu and Decandolle.

Fries (frēs), Jakob Friedrich, a German philosopher, born 1773, died 1843. He studied at the Universities of Leipzig and Jena; in 1805 became professor of philosophy and mathematics at Heidelberg, and in 1816 was appointed to the chair of theoretical philosophy at Jena. His works are numerous, the most important being *Neue Kritik der Vernunft*, *System der Philosophie als evidente Wissenschaft*, and *Wissen, Glaube und Ahnung*. He aimed in his philosophical system at effecting a reconciliation between the critical philosophy and faith.

Friesland, the most northerly province of Holland, sometimes called West Friesland to distinguish it from East Friesland, now the district of Aurich in Hanover. It is generally flat,



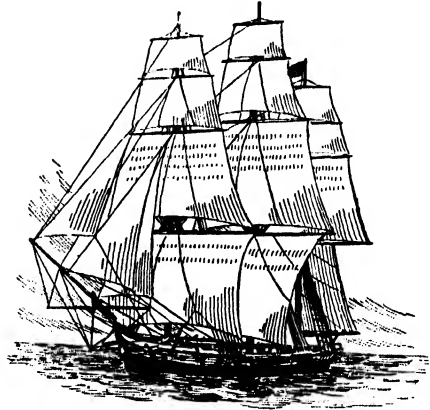
Frieze of the Choric Monument of Lysicrates, Athens

and parts of it are below sea-level. The area is 1243 sq. miles, four-fifths of which are under cultivation. Leeuwarden is the capital. Pop. 384,779 (1918). See *Frisians*.

Frieze (frēz), in architecture, that part of an entablature which lies between the architrave and cornice. It is flat, and usually enriched with figures or other ornaments. (See *Entablature*.) Also an ornamental strip below any cornice.

Frig'ate, in the navy, an obsolete term applied to a vessel of a size larger than a sloop or brig and less than a ship of the line; usually carrying

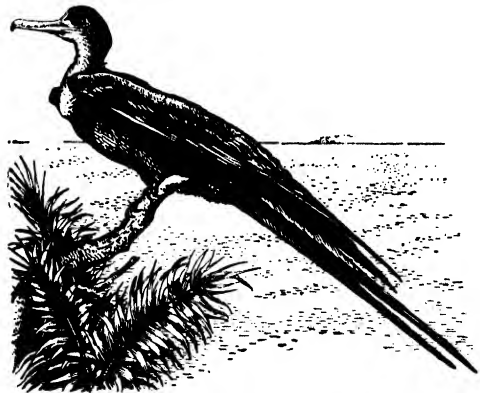
her guns (which varied from about thirty to fifty or sixty in number) on the main deck and on a raised quarter-deck and forecastle, or having two decks. Such ships were often fast sailers, and were much employed as cruisers in the great wars of the eighteenth and early part of



Frigate. Studding sails omitted

the nineteenth centuries. Since the introduction of iron-clad vessels the term *cruiser* has been applied to ships taking the place of the frigates of former days.

Frigate-bird, or Man-of-war Bird (*Fregata aquila*), a tropical web-footed bird, the type of



Frigate-bird (*Fregata aquila*)

a family (*Fregatidae*) allied to the pelicans. Including the long tail, the male bird reaches 3 feet in length, but the body is comparatively small. The bill is longer than the head, strong, hooked at the point, and sharp. In proportion to the size of the body the wings are longer than those of any other bird, having an extent of

7 feet or more. The flight of the frigate-bird is powerful and graceful. It neither swims nor wades, but catches flying-fish in the air or forces fishing-birds in flight to let go of their prey, which the frigate-bird dexterously seizes as it falls.

Frigga, or **Frigg**, in northern mythology, the wife of the god Odin, the goddess after whom Friday (O.E. *Frigedæg*) is named. She is a goddess in some respects corresponding with Venus, and is often confounded with Freya (q.v.).

Frilled Lizard, an Australian lizard, *Chlamydosaurus Kingii*, so called from a curious membrane-like ruff or tippet round its neck, covering its shoulders, which lies back in plaits when the animal is tranquil, but which rises when it is irritated or frightened. It can run for some distance on its hind legs. A full-grown specimen is about 3 feet in length.

Frimaire (frē-mār; Fr., from *frimas*, hour-frost), the third month of the French republican calendar, dating from 22nd Sept., 1792. It commenced 21st Nov., and ended 20th Dec.

Fringe Tree (*Chionanthus virginica*), a small tree belonging to the same natural family as the olive, and having snow-white flowers which hang down like a fringe, found in America from lat. 30° to the Gulf of Mexico. It is frequently cultivated in gardens as an ornamental plant. Four other species of *Chionanthus* are known, two of which are found in the West Indies, the third in Ceylon, and the fourth in Australia.

Frisches-Haff, an extensive lagoon of Prussia, on the Baltic, from which it is separated by a long and narrow line of low gravel and sand-banks called the Frische-Nehrung, and with which it communicates by a narrow strait, on the north side of which is the town of Pillau.

Frisians, a German tribe who, about the beginning of the Christian era, occupied the territory between the mouths of the Rhine and the Ems. They became tributaries of Rome under Drusus, and lived for some time on friendly terms with their conquerors, but were driven to hostilities by oppression. In time they extended as far eastward as Slesvig, and even made settlements on the Firth of Forth, and probably in other parts of Northern Britain. About the end of the seventh century the Frisians in the south-west were subdued by the Franks under Pépin d'Héristal, who compelled them to accept Christianity. A century later the eastern branch of the tribe was conquered and Christianized by Charlemagne. Their country was divided into three districts, two of which were annexed, on the division of the Carlovingian Empire, to the possessions of Louis the German, and the other to those of Charles the Bald. The latter part was called West Frisia (W. Friesland), and the two former East Frisia (E. Friesland).

Their modern history is chiefly connected with Holland and Hanover. The *Frisian Language* holds in some respects an intermediate position between Anglo-Saxon and Old Norse. Of all the Teutonic dialects it is the most nearly related to English. Its ancient form exists only in some remarkable collections of laws. Three dialects of it are now recognized: the West Frisian, spoken in the Dutch province of Friesland, about Leeuwarden, Bolsward, &c., and used to some extent in literature; the East Frisian, spoken between the mouths of the Ems and Weser; and the North Frisian, spoken on the west coast of Schleswig and South Jutland, and on the islands Sylt, Föhr, Amrun, &c.

Frit (*Oscinis frit*), a small greenish-black fly, the larvæ of which do great damage to barley crops in some parts of the north of Europe, and to oats in Britain.

Frith, William Powell, R.A., born at Studley, near Ripon, in 1810, died in London 1900; studied at the Royal Academy School and practised portrait painting. From 1840, when he exhibited his *Malvolio* at the Royal Academy, he produced a great number of scenes from Shakespeare, Molière, Dickens, Sterne, Goldsmith, &c., besides his immensely popular pictures, *Coming of Age in the Olden Time* (1849), *Life at the Sea-side* (1854), *Ramsgate Sands* (1854—bought by Queen Victoria), *The Derby Day* (1858—now in the National Gallery), *The Railway Station* (1862), *Before Dinner at Boswell's Lodgings* (1868—sold in 1875 for £4507), *The Private View at the Royal Academy* (1881), &c. He was commissioned by Queen Victoria to paint the marriage of the Prince of Wales. He was elected A.R.A. in 1845, and R.A. in 1852, and was a member of several foreign academics. Large engravings have been produced from a number of his pictures. In 1887-8 he published his autobiography, 3 vols. 8vo.

Frith Gilds, among the Anglo-Saxons, voluntary associations of neighbours for purposes of order and self-defence. They repressed theft, traced stolen cattle, and indemnified, from a common fund raised by subscription, members who had been robbed.

Frithjof (frēt'yof), an Icelandic hero, supposed to have lived in the eighth century. After a series of adventures, recorded in an ancient Icelandic saga of the thirteenth century, he marries Ingebjörg, the widow of the king Hring. The story forms the groundwork of Tegner's popular poem *Frithjof's Saga*, and has been frequently translated.

Fritillary (*Fritillaria*), a genus of plants, nat. ord. Liliacæ, natives of north temperate regions. *F. Meleagris*, or common fritillary, is found in meadows and pastures in the eastern and southern parts of England. Several species, as *F. im-*

perialis or crown-imperial, are cultivated in gardens, chiefly introduced from Persia and the warmer parts of Europe.

Fritillary, the popular name of butterflies belonging to the largest and most widely distributed family (Nymphalidae), comprising between 4000 and 5000 species, and distinguished by the reduced condition of the front pair of legs, which are useless for walking. British species are: silver-washed fritillary (*Argynnis paphia*), dark-green fritillary (*A. aglaia*), queen of Spain fritillary (*A. latonia*), great tortoiseshell (*Vanessa polychloros*), small tortoiseshell (*V. urticae*), peacock (*V. io*), red admiral (*V. atalanta*), painted lady (*V. cardui*), purple emperor (*Apatura iris*). Some of the most gorgeous tropical butterflies, such as species of *Morpho*, belong to the same family.

Friuli (fri-ō'le), formerly an independent duchy at the head of the Adriatic, and from 1866 to 1918 forming part of Italy and Austria. It was one of the most important duchies of the Longobard Kingdom, and up to the fifteenth century, when it was conquered by Venice and its territories dismembered, it retained a considerable degree of independence. The inhabitants, called Furlani, are Italian for the most part, but speak a peculiar dialect. Since the Treaty of Rapallo (1920), Friuli now entirely belongs to Italy, although the Austrian portion of it was claimed by Yugo-Slavia.

Frobisher, Sir Martin, one of the great Elizabethan navigators, born near Doncaster, England, about 1535, died at Plymouth 1594. He made three expeditions to the Arctic regions for the purpose of discovering a north-west passage to India, and endeavoured to found a settlement north of Hudson Bay, hopes of immense wealth to be found in these northern regions having taken the public fancy. In 1585 he accompanied Sir Francis Drake to the West Indies. In the fight with the Spanish Armada in 1588 he commanded one of the largest ships in the fleet, and was knighted for his services. In the years 1590 and 1592 he commanded squadrons against the Spaniards and took many rich prizes. In 1594 he was sent to the assistance of Henry IV of France, when, in an attack on a fort near Brest, he was mortally wounded.—BIBLIOGRAPHY: Hakluyt Society Publications; Rev. F. Jones, *Life of Frobisher*.

Froebel (freu'bél), Friedrich Wilhelm August, German educationist, born 1782, died 1852. After an unsettled and aimless youth, and with somewhat imperfect culture, he started teaching, and soon developed a system which has become famous under the name of *Kindergarten* (q.v.). He is the author of *Die Menschenerziehung*, and *Mutter- und Koselieder*, a book of poetry and pictures for children. A Froebel Society, for the

promotion of the Kindergarten system, was established in 1874. See *Education*.—BIBLIOGRAPHY: R. H. Quick, *Educational Reformers*; D. J. Snider, *Life of F. Froebel*.

Frog, the common English name of a number of animals belonging to the class Amphibia, having four legs with four toes on the fore feet and five on the hind, more or less webbed, a naked body, no ribs, and no tail. Owing to the last peculiarity frogs belong to the order of amphibians known as Anura or tailless Amphibia. They constitute the family Ranidae, which ranges over most of the world, except Australia (save the extreme north-east), New Zealand, and South America (south of the



Common Frog (*Rana temporaria*)

Showing the stages of growth from the egg to the fully-developed frog.

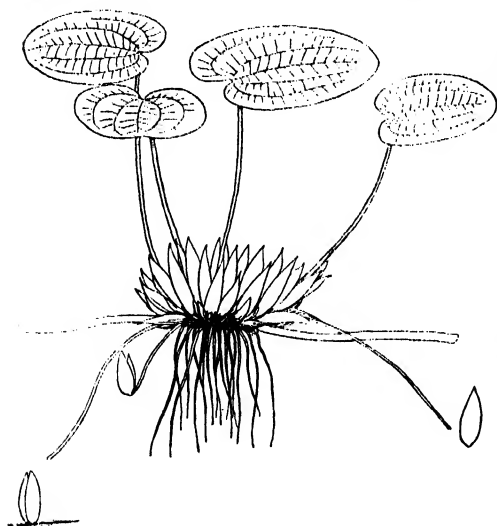
equator). Typical species are the common or grass frog (*Rana temporaria*), edible frog (*R. esculenta*), and the bull frog (*R. catesbeiana*) of North America. The tongue is fleshy, and is attached in front to the jaw, but is free behind, so that its hinder extremity can be shot out to catch insects. Frogs are remarkable for the transformations they undergo before arriving at maturity. In the spring the spawn is deposited in ponds and other stagnant waters in large masses, each blackish egg being surrounded by a gelatinous sphere. The eggs hatch out into fish-like tadpoles, which at first breathe by external and later on by internal gills. The adult form is reached by loss of gills and tail, and the development of lungs and limbs.

Frog-bit (*Hydrocharis morsus-ranæ*), ord. Hydrocharitaceæ, a small water-plant of England, with floating kidney-shaped leaves, and white flowers of three petals.

Frogmore, an English royal palace in the Little Park, Windsor. In the grounds is the Mausoleum where rest the remains of the Duchess of Kent, the Prince Consort, and Queen Victoria.

The building is in the shape of a Greek cross, with a central dome 70 feet high.

Froissart (frwá-sár), Jean, a French poet and historian, was born in 1337 at Valenciennes, died in Flanders between 1400 and 1410. He received a liberal education, and took orders in the Church, but his inclination was more for poetry and gallantry. At the age of eighteen he went to England, where, having already the reputation of being a gay poet and narrator of chivalric deeds, he was received with great favour, Philippa of Hainault, wife of Edward III, declaring herself his patroness. After returning to the



Frog-bit

The winter buds in process of detachment from the ends of the submerged rhizomes.

Continent and travelling for some time, he again visited England, and from 1361 to 1366 he was a secretary to the queen. He also visited Scotland, and was entertained by King David Bruce, and William, Earl of Douglas. In 1366 he left England and again travelled. After the death of Queen Philippa, Froissart became *curé* of Lestines in Hainault, and was patronized by Wenceslaus, Duke of Brabant, who was himself a poet, and of whose verses, united with some of his own, Froissart formed a sort of romance called *Meliador*. On the death of Wenceslaus he entered the service of Guy, Count of Blois, who gave him the canonry of Chinay, and induced him to take in hand the history of his own time. After twelve years of a quiet life he again began his travels, chiefly for the purpose of collecting further matter for his *Chronicle*, and he again visited England after a lapse of forty years. Little is known of the closing part

of his life, which is said to have terminated at Chinay. His *Chronicle*, which reaches down to 1400, gives a singularly vivid and interesting picture of his times, and also presents his own character in a pleasing light. The best editions of his *Chronicle* are those of Buchon, which also contains his collected *Poésies* (Paris, 1835-6, 3 vols.), of Kervyn de Lettenhove (Brussels, 1863-77, 25 vols.), and of S. Luce (Paris, 1869-88). The earliest, and in some respects the best, English translation is that of Lord Berners (London, 1525), although that by Thomas Johnes (1803-5) is more exact.—Cf. Madame Darmesteter (Duciaux), *Froissart*.

Frome, or **Frome-Selwood**, a town, England, county Somerset, on a small river of the same name, 19 miles south-east of Bristol. The staple manufactures are woollen cloths. Previous to 1885 it sent one member to Parliament; it now gives its name to a parliamentary division. Pop. 10,506.

Frond, in botany, a term often applied to the leaves of ferns and other cryptogamous plants.

Fronde (frond), a French party during the minority of Louis XIV, which waged civil war against the Court party on account of the heavy fiscal impositions laid on the people by Cardinal Mazarin, whom the queen-mother had appointed Prime Minister after the decease of Louis XIII (1648). At the head of the Fronde stood the Cardinal de Retz (q.v.), and afterwards the Prince Louis Condé. The result of this contest, which lasted from 1648 to 1654, served only to strengthen the royal power. The name is from Fr. *fronde*, 'a sling', a member of the Parliament having likened the party to boys slinging stones in the streets, who dispersed on the appearance of the authorities.—Cf. G. S. Gordon, *The Fronde*.

Frontinus, Sextus Julius, a Roman of patrician descent, born about A.D. 40, died 106. He was Governor of Britain from 75 to 78, and distinguished himself in the Wars of the Silures. He appears to have been twice Consul, and was appointed by Nerva to superintend the aqueducts, on which he also wrote. His *De Stratagematibus*, a treatise on war, and his *De Aqueductibus Urbis Romæ* are still extant.

Fronto, Marcus Cornelius, Roman orator and rhetorician of the second century after Christ, born at Cirta in Numidia. Having removed to Rome, he won the special favour of Hadrian and Antoninus Pius, and was appointed tutor to the imperial princes Marcus Aurelius and Lucius Verus. His extant remains consist chiefly of some letters to these princes, discovered in 1815 and published in 1823.

Froschdorf (frosh'dorf; called by the French *Frohsdorf*), a village in Lower Austria, on the

River Leitha, about 30 miles from Vienna. It is remarkable for its magnificent castle, which has acquired a kind of political importance since 1844, when it became the head-quarters of the Bourbon party. It was the favourite residence of the Comte de Chambord (died in 1883), who greatly improved and beautified the interior.

Frost is the name we give to the state of the weather when the temperature is below the freezing-point of water (32° F.). The intensity of the cold in frost is conveniently specified in *degrees of frost*, or the number of degrees by which the temperature of the atmosphere is below the point at which the freezing of water commences. Frost is often very destructive to vegetation, owing to the fact that water, which is generally the chief constituent of the juices of plants, expands when freezing, and bursts, and thus destroys, the vesicles of the plant. In the same way rain-water, freezing in the crevices of rocks, breaks up their surfaces, and often detaches large fragments. When the dew-point, or temperature at which the air would just be able to hold the quantity of aqueous vapour it actually contains, is below 32° F., and the air is cooled to that dew-point, the vapour is deposited directly in the solid form, as *hoar frost*. On the other hand, if the vapour has first been deposited at a higher temperature, and the ground is subsequently cooled below 32° , there is the phenomenon of frozen dew. *Rime* is distinct from hoar frost. It is produced during fogs by accumulation of frozen moisture on trees or other objects. *Glazed frost* is a transparent coating of ice, due to the freezing of rain after falling, or the contact of moist and comparatively warm air with very cold surfaces.

Frost-bite is caused by the freezing of the superficial tissues of the body. The skin of an area, e.g. an ear, a finger, or a toe, may be frozen hard and no ill effects follow thawing, but more commonly after thawing the skin of the affected part becomes red and swollen and covered with blebs. Later, parts of the skin and underlying tissues may die and come away as a dry gangrenous mass. The extent of the damage depends on the duration of the cold and its intensity. During the process of thawing, intense pain is experienced, which passes away, to be followed by itching and tingling. The result is great deformity if the nose or ears are affected. During the winter months of the European War (1914-8) in France many soldiers were inviolated with so-called frost-bite of the feet. This was known later as trench-foot, and was not true frost-bite, but was due to changes in the blood-supply of the feet, brought on by prolonged exposure to damp conditions.

Frosted-glass, glass roughened on the surface, so as to destroy its transparency, in con-

sequence of which the surface has somewhat the appearance of hoar-frost.—The term *frosted* is also applied to the dead or lustreless appearance of gold and silver jewellery when the surface is unpolished.

Froth-fly, or **Frog-hopper**, the common name of hemipterous insects of the family Cercopidae, the immature stages of which are found in a frothy exudation on plants. See *Cuckoo-spit*.

Froude (fröd), James Anthony, historian and miscellaneous writer, born at Totnes, Devonshire, 1818, died 1894. He was educated at Oxford, was elected Fellow of Exeter College, and received deacon's orders. In 1848 he resigned his fellowship and withdrew from orders on the publication of his *Nemesis of Faith*. Between the years 1856 and 1869 appeared his great work *The History of England from the Fall of Wolsey to the Defeat of the Spanish Armada*, which was very popular, though it received but doubtful approval from historians. He was for some time editor of *Fraser's Magazine*, to which he contributed many articles, as well as to other periodicals. In 1869 he was elected rector of St. Andrews University; travelled in the United States in 1874; and visited the Cape Colony on a political mission, 1874-5. He was made literary executor to Carlyle, and his *Life of Carlyle*, *Carlyle's Reminiscences*, and *Letters and Memorials of Jane Welsh Carlyle*, as edited by him, provoked an extraordinary amount of interest and controversy. Among his other works are: *Short Studies on Great Subjects*; *The English in Ireland in the Eighteenth Century*; *Julius Caesar*; *Oceana, or England and her Colonies*; and *The English in the West Indies*.—BIBLIOGRAPHY: Herbert Paul, *Life of Froude*; A. Cecil, *Six Oxford Thinkers*.

Fruç'tidor, the twelfth month of the French republican calendar (dating from 22nd Sept., 1792), beginning 18th Aug., and ending 16th Sept.

Fruit, in botany, the mature ovary of a plant,

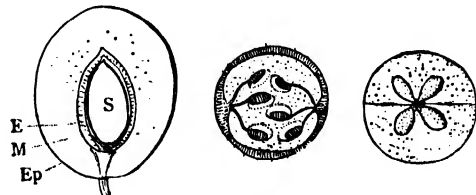


Fig. 1.—Succulent Fruits. Sections: Plum (drupe), Gooseberry and Grape (berries)

S, Seed. E, Endocarp. M, Mesocarp. Ep, Epicarp or skin.

composed essentially of two parts, the pericarp and the seed. In a more general sense the term is applied to the edible succulent products of

certain plants, generally covering and including their seeds. The hardier sorts of fruits, such as are indigenous to Britain, or which have been cultivated to any important extent there, are the apple, pear, plum, cherry, apricot, peach, and nectarine; the gooseberry, currant (red, white, and black), raspberry, strawberry, mulberry. The more important fruits requiring a warmer climate are the fig, date, grape, orange, lime, banana, tamarind, pomegranate, citron, bread-fruit, olive, almond, melon, and coco-nut. Some fruits are of immense economic importance, either as food for great numbers of people, or as the basis of beverages in extensive use. The

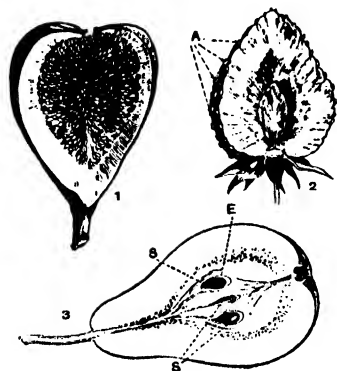


Fig. 2.—Spurious Fruits. 1, Section of fig; 2, of strawberry; 3, of pear.

S, Seed. E, Endocarp. A, Achenes.

date is a type of the first class, and the grape, from which wine is produced, of the second. The total value of the fruit imported into the United Kingdom in 1913 was over £16,000,000; in 1919 it was about £55,000,000. See *Botany*.

Fruit-pigeon, the name given to the pigeons included in *Carpophaga* and related genera, birds of very brilliant plumage, occurring in India and the warmer parts of Australia. They are so called because they feed entirely on fruit.

Frustum, in geometry, the part of a solid next the base, left by cutting off the top portion by a plane parallel to the base; or the part of any solid between two planes, which may be either parallel or inclined to each other, as the *frustum* of a cone, of a pyramid, or of a sphere, the last of which is any part comprised between two parallel circular sections.

Fry, Elizabeth, philanthropist, the third daughter of John Gurney, of Earham Hall, near Norwich, was born 1780, died at Ramsgate 1845. In her eighteenth year a sermon preached by William Savery, an American Quaker, at Norwich, had the effect of turning her attention to serious things, and making her

adopt decided views on religious matters. About this time also she made the acquaintance of Joseph Fry, a London merchant and a strict Quaker, to whom she was married in 1800. In 1810 she became a preacher among the Friends. Having paid a visit to Newgate in 1813, she was so impressed by the scene of squalor, vice, and misery which she there witnessed, that the amelioration of prison life became with her a fixed object. In 1817 she succeeded in establishing a ladies' committee for the reformation of women-prisoners in Newgate, along with a school and manufactory in the prison, the results of which proved eminently satisfactory. These improvements were shortly afterwards introduced by her means into other prisons. In the pursuit of her philanthropic labours she made tours through various parts of the United Kingdom, and also visited France, Belgium, Germany, and Holland.—Cf. G. King Lewis, *Elizabeth Fry*.

Fryatt, Charles, British sailor, born 2nd Dec., 1872, shot by the Germans on 27th July, 1916. Entering the merchant service in 1904, he obtained his master's certificate in 1905, and was promoted captain in 1913. During the European War, Captain Fryatt's ship, the cross-Channel steamer *Brussels*, was attacked by a German submarine on 3rd March, 1915, but escaped. On the 28th of the same month it was again attacked by a U-boat near the Maas Lightship, and almost succeeded in ramming the submarine. Captain Fryatt was thanked by the British Admiralty for his action, but the enemy pretended that he had acted against the usages of war, as he did not belong to the combatant forces. On 23rd June, 1916, Captain Fryatt was captured by a German destroyer, taken to Zeebrugge, and thence to Ruhleben and Bruges, where he was tried by court-martial as a *franc-tireur*. Sentenced to death on 27th of July, he was shot on the same day. After the conclusion of the European War, Captain Fryatt's body was brought to England and buried at Dovercourt on 9th July, 1919.

Fuad, Ahmed Fuad Pasha, Sultan of Egypt, born 26th March, 1868, the youngest son of Ismail Pasha, and brother of Hussein Kamil, the first Sultan of Egypt. He was educated in Italy and Switzerland, and at the Artillery School at Turin. He succeeded his brother as Sultan of Egypt on 9th Oct., 1917.

Fuad Pasha, Mehemed, Turkish statesman and man of letters, was born at Constantinople 1814, died at Nice 1869. His diplomatic career took him to London, Madrid, and Russia; he was four times Minister of Foreign Affairs, and for five years Grand Vizier; and was the chief support of the reform party in the Turkish Empire. He wrote poetry, political pamphlets, and a Turkish grammar, which has been translated into several languages.

Fuca'cæ, a nat. ord. of dark-coloured Algæ, consisting of olive-coloured sea-weeds, distinguished by their organs of reproduction, which consist of oogonia and antheridia, contained in chambers or conceptacles, united in club-shaped receptacles at the ends or margins of the fronds. Fucaceæ exist in all parts of the ocean, and, though all are probably occasionally attached, they may persist as floating masses, like the gulf-weed. See *Fucus*; *Brown Algæ*.

Fu-chow. See *Foo-chow*.

Fuchsia (fū'shi-a; named after the discoverer, Leonard *Fuchs*, a German botanist), a genus of beautiful flowering shrubs, natives of South America, Mexico, and New Zealand, nat. ord. Onagraceæ, characterized by having a funnel-shaped, coloured, deciduous, four-parted calyx, sometimes with a very long tube; four petals set in the mouth of the calyx-tube and alternating with its segments; eight exerted stamens, and a long style with a capitate stigma. This is one of our most common decorative greenhouse plants, while the hardy varieties out of doors in the open border form an important feature with their wonderful profusion of flowers.

Fucino, or **Celano** (fū'chē-nō, chel-ä'nō: Lat. *Fucinus Lacus*), formerly a lake of Southern Italy, about 11 miles long and 5 miles broad, 2181 feet above sea-level, in the province of Aquila in the Central Apennines. As the lake often rose and submerged the neighbouring lands, the Emperor Claudius caused a tunnel to be constructed to carry off its surplus waters into the Garigliano. This vast work was soon allowed to fall into disrepair. Between 1852 and 1876, however, it was repaired and enlarged by a company, and the lake has now been thoroughly drained, and 36,000 acres of rich arable land reclaimed.

Fucus, a genus of sea-weeds, family Fucaceæ, comprising various common sea-weeds which have a flat or compressed forked frond, sometimes containing air-vessels. Many of the species are exposed at low water; they form a considerable proportion of the sea-weeds thrown up on some coasts, and are used for manure and for making kelp. Most contain iodine.

Fuego. See *Tierra del Fuego*.

Fuels are materials which can be burnt economically for the generation of heat to be applied to some useful purpose, such as domestic heating, steam raising, firing of furnaces, &c. They may be solid, liquid, or gaseous, and may be used in the natural state or after being prepared by some suitable process.

Solid fuels contain combustible matter consisting largely of carbon and hydrogen either combined or in the free state, and incombustible matter in the form of ash. Liquid and gaseous fuels consist mainly of combustible matter, and

generally contain little ash. The combustible matter in solid fuels is present in two forms, viz. volatile matter, which is driven off when the substance is submitted to heat out of contact with air, the residue left behind being charcoal when wood is heated, and coke when coal is heated, each of these materials consisting of fixed carbon together with the ash present in the original material.

The natural fuels are wood, peat, coal, natural oils, and natural gas. Wood may be considered as the natural fuel of man; it was the first and for many ages the only fuel with which he was acquainted. It is still used to some extent for domestic purposes, and in certain parts of the world for some industrial purposes also. It cannot be considered a satisfactory fuel, owing to the large amount of water it retains. In the growing condition, the cells and vessels are filled with sap, and freshly-felled wood contains about 50 per cent of water, the amount varying with the nature of the wood, the part of the tree from which it is taken, the age of the tree, and the season of felling. A tree which has had its bark stripped off, and has been exposed to the air, loses moisture, and the remaining air-dried wood contains 15 to 25 per cent of water. During the burning of the wood much heat is used up in the evaporation of the water remaining.

Peat consists of partially-decayed vegetable matter occurring in beds of varying thickness from a few feet upwards. In this country the peat is composed almost entirely of the remains of mosses. The top layers of the peat-bogs contain tangled roots and stems of plants only slightly decayed, are light-brown in colour, and of low specific gravity. Lower down the material becomes darker and denser, and at the greatest depth it may have passed into a nearly black compact mass in which all trace of the original matter is lost. When freshly got, peat contains up to 80 per cent of water, and after air-drying, contains 10 to 15 per cent. Peat, even in the air-dried condition, is not a good fuel, as it contains too much water, and may in addition contain a considerable amount of ash. There is a tendency, however, towards the increased use of peat as a fuel, and there is every probability that peat and peat products will become much more important as fuels in the future than they have been in the past. It is estimated that there are over 9000 sq. miles of peat deposits in Great Britain.

Coal is by far the most important natural fuel. In its strictly correct usage the name comprises only the compacted carbonaceous materials such as lignite, bituminous coals, and anthracite. Lignite or brown coal differs from ordinary coal in being the result of partial mineralization of vegetable tissues. It is used for domestic,

manufacturing, and locomotive purposes in districts remote from ordinary coal-fields. Bituminous coals include all the most important classes of carboniferous fuel, and are divided by Sir Richard Redmayne into the following classes: (1) gas, (2) coking, (3) house, (4) manufacturing or iron smelting, and (5) steam, which grade one into the other. The names given to the different classes signify the purposes for which they are most suitable.

Anthracite represents a stage of mineralization beyond coal. It contains up to 98 per cent of carbon and very little volatile matter. Owing to its hard and compact structure and difficulty of ignition, it is only useful for steam raising where forced draught is used. It is largely used for malting purposes and for drying hops, where a steady heat is required; for domestic purposes and hot-house heating it is burnt in specially-designed stoves, and is also used to some extent in iron smelting and in the manufacture of producer-gas. The importance of coal as a fuel may be realized from the fact that the estimated world's production of coal in 1918 was about 1321 million tons, and in 1919 about 1130 million tons.

Natural oils or petrolcums are found in many parts of the world, and are largely used as fuel for steam raising and general industrial purposes. Before use, they are generally submitted to distillation, and are thus to an extent prepared fuels, and will be considered below.

Natural gas occurs in certain localities in very large quantities, and in Pennsylvania has been used as a fuel on a large scale. The first attempts at using the gas were made in 1879, when pipes were laid to convey the gas to the works in Pittsburg. The pressure of the gas at Pittsburg varies between 100 and 200 lb. per square inch. Natural gas is composed chiefly of marsh gas, with some hydrogen and nitrogen, and has a high heating value.

Prepared fuels may be either solid, liquid, or gaseous in form, the chief prepared solid fuels being charcoal, peat charcoal, peat briquettes, coke, coalite or semi-coke, coal briquettes, and pulverized coal.

Charcoal is the result of heating wood out of contact with the air, by which means the volatile matter is driven off, and a carbonaceous residue is left which retains the form of the wood so perfectly that it shows distinctly the annual rings of growth of the wood. Charcoal was at one time a very important fuel, but is now mainly used only where wood is abundant and coal is scarce. It is still used for certain metallurgical purposes with advantage, owing to its freedom from injurious substances. It is made in heaps, kilns, and for special purposes in iron retorts.

With regard to prepared peat fuel, the chief

problem in its economic utilization consists in freeing it from the excessive amount of water it contains, and many mechanical systems of treating peat by consolidation have been tried. Recent experiments by the Fuel Research Board, which was established in 1917, have shown that machine-cut peat dries more quickly than peat cut by hand-power, which is unmacerated. By the thorough maceration of the peat material, followed by briquetting and drying, the best peat briquettes are made. Peat charcoal has been made to some extent by pulping the peat, pressing the mass into blocks, and then charring in retorts.

Coke is by far the most important prepared fuel at the present time, especially from a metallurgical point of view. It is the product obtained by heating coal without access of air, when volatile gaseous and liquid matters are given off, and a residue of coke is left which consists of the fixed carbon plus the ash of the original coal. There are two classes of coke on the market, gas-coke, which is obtained as a by-product in the coal-gas industry; and metallurgical coke, which is a hard coke produced by the carbonization of selected coals in special ovens at a very high temperature.

In addition to these classes of coke there is a product obtained by low-temperature carbonization, originally known as coalite. Gas-coke is suitable for ordinary fires and for domestic purposes, as it ignites more readily than metallurgical coke, owing to its higher content of volatile matter, and when burnt in suitable grates or stoves, forms an excellent domestic fuel. It is smaller in size than oven coke, and is more vesicular, more friable, and softer, and is therefore unsuitable for use in blast-furnaces, since it is incapable of sustaining the burden without crumbling. Metallurgical or blast-furnace coke, on the other hand, is large in size and combines great strength with porosity. The coal selected for its manufacture is of a strong caking variety, low in ash, and generally contains from 20 to 30 per cent of volatile matter. This class of coke is manufactured either in beehive ovens, in which the valuable by-products such as tar, ammonia, &c., are lost, or in specially designed coke ovens arranged for the recovery of these by-products. The practice of by-product coking had become almost universal in Germany before the European War, and in the United Kingdom by-product ovens are gradually replacing other forms, in 1919 about 80 per cent of the metallurgical coke made here being produced in by-product ovens.

In the manufacture of coalite and similar low-temperature carbonization products, a temperature of about 400° to 500° C. is used, and a large increase in the tarry-matter products is obtained,

together with a friable coke which kindles and burns quickly.

Coal briquettes have become of considerable importance within recent years. They are usually made of fine coal compressed with some form of cementing material. Tar or pitch is generally used, but dextrine, molasses, clay, Portland cement, lime, &c., have also been suggested, and there are many forms of presses used in their manufacture.

The burning of finely-pulverized coal for steam raising, furnace purposes, &c., has made great strides during recent years, although it has been used for many years in special industries, such as in Portland cement kilns. For this purpose dried and finely-powdered coal is blown through special burners, and under proper conditions behaves practically as a fluid.

The prepared liquid fuels consist of distillation products from the treatment of natural oils, the products of distillation of oil shales, and various oil and tarry matters from gasworks, coke-oven plants, gas producers, and blast-furnaces. By the distillation of natural oils, the lighter oils are first obtained for special purposes, and the residue is used for fuel oil. Large quantities of oil are obtained from the distillation of bituminous shales, the product being submitted to fractional distillation for the separation of oils having different qualities and uses. Blast-furnace and other tars are also submitted to fractional distillation, yielding light oils, fuel oils, and pitch. The utilization of oil fuels has many advantages over solid fuels, including the following: a reduction in weight of about 40 per cent, and in volume by about 35 per cent; a reduction in the number of stokers required; a very small amount of ash to be handled and disposed of; prompt kindling and early attainment of maximum temperature. The fires may also be extinguished at any moment, and great uniformity of combustion and hence heating power is obtained. The advantages of liquid fuel are rapidly being realized, and, by means of specially-designed burners, oil is being used in steamships, power-stations, and for many industrial purposes, including metallurgical furnaces.

With regard to artificial gaseous fuel, there are many types used for lighting and heating purposes. These include ordinary coal-gas, coke-oven gas, producer-gas, water-gas, oil-gas, and waste-furnace gas, especially that from iron blast-furnaces. Coal-gas is obtained by heating coal in closed retorts, and is used for lighting purposes, and to a considerable extent for domestic heating. Generally speaking, it is too expensive for furnace heating, but there are many minor operations in which its use is convenient. From the similarity of the operations

involved, it will be realized that coke-oven gas is not dissimilar from coal-gas, and in many districts it is used for domestic and special purposes, the gas necessary for heating the ovens being made specially in producers from coke.

Producer-gas is the most important gaseous fuel used in the industries, and is made by the partial combustion of coal or coke, with a limited supply of air, in specially-designed chambers known as producers. Although a certain amount of the total heat of combustion of the fuel is developed in the producer itself, this is compensated for by the introduction of a certain amount of steam with the air. In contact with incandescent fuel, this steam is decomposed, giving hydrogen and carbon monoxide, two combustible gases which greatly increase the heating power of the gas. The air blown into the producer with the steam results in the introduction of nitrogen, which dilutes the gas, so that its calorific value is somewhat low.

For special purposes water-gas is used, which results from the decomposition of steam alone by means of carbon in an incandescent state; this water-gas is a rich gas consisting practically of hydrogen and carbon monoxide. As it is necessary to supply a considerable amount of heat for this reaction to take place, the operation is intermittent in action, the supply of steam to the producer being cut off from time to time, and air blown through to render the carbon incandescent. If this were not done, the temperature of the producer would gradually fall until steam passed through unaltered.

Oil-gas is made by the destructive distillation of oil at a high temperature, with or without the use of steam; it is largely used for lighting purposes, and is also used for furnace work on a small scale.

The gas evolved from certain metallurgical furnaces, and especially from iron blast-furnaces, is very similar in composition to ordinary producer-gas, and forms a valuable gaseous fuel. It is largely used for firing boilers, heating the hot-blast stoves in connection with the furnaces, and direct in gas-engines. Great attention is being given to the thorough cleaning of the gas, as its efficiency as a source of heat is greatly increased in this way.

The use of gaseous fuel in the various industries has many advantages, including the following: the perfect control under which the supply of gas and air may be maintained; perfect combustion without smoke may be obtained with only a very slight excess of air over that necessary for combustion; much higher temperatures can be obtained than are possible with solid fuel, especially when both the gas and the air are preheated; a commoner fuel may be used; and the gas can be conveyed to different parts

of the works through pipes with great ease.—**BIBLIOGRAPHY:** W. A. Bone, *Coal and its Scientific Uses*; Sexton and Davidson, *Fuel and Refractory Materials*; H. S. Jevons, *The Coal Trade*.

Fuente (fy-en'tā; i.e. 'fountain'), with affixes, the name of numerous small towns in Spain. *Fuente-de-Cantos*, province of Badajoz, on the north slope of the Sierra Morena, has 8500 inhabitants; *Fuente-ovejuna*, province of Cordoba, has 11,880.

Fuentes d'Ono'ro, a village of Spain, province of Salamanca, about 16 miles w.s.w. of Ciudad Rodrigo, the scene of two engagements fought between Wellington and Masséna on 3rd and 5th May, 1811, the result of which was that the French were forced across the Portuguese frontier, and an end was put to the French invasion of Portugal.

Fuero (fy-ā'rō), a Spanish word signifying jurisdiction, law, privilege, and applied historically to the written charters of particular districts and towns. In 1833 a civil war broke out in the Basque provinces, in assertion of the *fueros* of that district, which lasted ten years, and was pacified only by the formal recognition of the Basque privileges in 1844 by the Queen and Cortes of Spain. The Basque *fueros*, however, were finally abrogated in 1876 as a result of the Carlist rising.

Fuerteventura, one of the Canary Islands, separated from Lancerota by the Strait of Bacuyna. Cabras on the east coast has a good harbour. Area, 700 sq. miles. Pop. about 12,000.

Fugger Family, a distinguished German family, early admitted among the hereditary nobility, and now represented by two main lines of descendants and several minor branches. The founder of this family was *Johann Fugger*, a master weaver who settled in Augsburg in 1308 and acquired much property. His descendants became leading bankers, merchants, and mine-owners; were liberal and public-spirited men, patrons of art, and several of them became distinguished soldiers and statesmen. Among the most eminent of the family was *Jakob Fugger* (1459–1525), who carried on great commercial operations, advanced money to the Emperors Maximilian and Charles V, and by the former was raised to the rank of nobleman, being also imperial councillor under both. Charles V raised Jakob's two nephews, Raimund and Anton Fugger, to the dignity of counts. He also invested them with the estates of Kirchberg and Weissenhorn, which had been mortgaged to them, granted them a seat at the Imperial Diet, and letters giving them princely privileges. Afterwards the highest places of the empire were held by the Fuggers, and lines of

counts and princes still represent the family.—*Cf.* A. Stauber, *Das Haus Fugger*.

Fugitive Offenders Act, 1881, provides for the arrest in any part of His Majesty's Dominions of persons accused of having committed certain offences in any other part, and for their being brought back to the *locus delicti* for trial. Upon apprehension a fugitive offender may be committed to prison in the place of arrest to await his return, and if committed must not be surrendered for trial for at least fifteen days thereafter, during which period he may apply for a writ of habeas corpus or other like process. If not surrendered for trial within one month of his committal, the fugitive may apply—if in England or Ireland to the High Court of Justice or the Court of Appeal, if in Scotland to the High Court of Justiciary, and if in a British possession to any court having the like criminal jurisdiction—to be discharged out of custody. The offences covered by the Act are treason, piracy, and every offence punishable in the *locus delicti* by imprisonment with hard labour for at least twelve months or by any greater penalty. A modified form of the regulations may be applied by Order in Council to any group of British possessions (excluding the United Kingdom, Channel Islands, and Isle of Man) lying contiguous or otherwise suitable, *quoad* the members of the group. See also *Extradition*.

Fugue (fūg; Lat. *fuga*, flight), a musical term signifying a polyphonic composition constructed on one or more short subjects or themes, which are harmonized according to the laws of counterpoint, and introduced from time to time with various contrapuntal devices, the interest in these frequently-heard themes being sustained by diminishing the interval of time at which they follow each other, and monotony being avoided by the occasional use of episodes, or passages open to free treatment.

Fuji-Yama, or **Fusi-Yama**, a dormant volcano of a symmetrical cone-like shape, in the Island of Honshū, Japan, the sacred mountain of the Japanese. It has been quiescent since 1707; is 12,400 feet in height, and is visible in clear weather for a distance of nearly a hundred miles.

Fulcrum, the point of support of a lever. In engineering, the body or pin supporting a lever; in mechanics, the point about which a lever turns, and through which the reaction of the lever on its support passes.

Fulda, a Prussian town, province of Hesse-Nassau, on a river of the same name, 54 miles s.s.e. of Cassel. It is irregularly built; contains a cathedral, a handsome edifice, erected at the beginning of the eighteenth century; a castle, once occupied by the prince bishops; a library of 50,000 volumes; and has manufactures of

cotton, woollen, and linen goods. The town derives its origin from a once-celebrated abbey founded by St. Boniface (Winfried), the apostle of Germany, in 744. Pop. 17,500.

Ful'gurite, any rocky substance which has been fused or vitrified by lightning. More strictly, a vitrified tube of sand formed by the intense heat of lightning penetrating the sand, and fusing a portion of the materials through which it passes.

Fulham (ful'am), a metropolitan borough of the county of London, bounded by the Thames, and the boroughs of Chelsea, Kensington, and Hammersmith. It contains the palace of the Bishop of London, and returns two members to Parliament. Pop. of municipal borough, 157,944.

Fu-lin. The country of Fu-lin is mentioned in Chinese texts as early as the beginning of the fifth century. It is vaguely referred to sometimes as a great island in the Western Sea (the Mediterranean) famous for its trees and precious stones. Of special interest is the fact that it was the scene of the Chinese version of the 'diamond valley legend'. The natives, reputed to be skilled in working implements and vessels of precious stones, obtained gems from a deep ravine. They threw down pieces of flesh, which were seized by eagles, and collected the precious stones, especially diamonds, that dropped from the flesh. This legend was carried from the Hellenistic Orient to China. There are two Fu-lins—the 'Lesser Fu-lin', which was Syria, and the 'Greater Fu-lin', which was the Byzantine Empire. According to Laufer, the name was originally Fu-lim or Fu-rim. As 'Rim' is still the Russian word for Rome, it is possible that Fu-lin was derived from a dialectic rendering of the capital of the Roman Empire.

Fuller (fyl'er), Andrew, English Baptist minister and theological and controversial writer, born 1754, died 1815. In 1782 he accepted the pastoral charge of a Baptist church at Kettering, in Northamptonshire, in which office he continued till his death. His theology was a moderate Calvinism, and he devoted much of his energy to the subject of foreign missions. His works, frequently reprinted, appeared in Bohn's Standard Library.

Fuller, Margaret. See *Ossoli* (Margaret Fuller).

Fuller, Thomas, an eminent historian and divine of the Church of England, born in 1608 at Aldwinkle, in Northamptonshire, died 1661. He was sent to Queens' College, Cambridge, where he graduated B.A. in 1625, M.A. in 1628. He afterwards removed to Sidney Sussex College in the same university; and being chosen minister of St. Benet's Parish, Cambridge, he became

very popular as a pulpit orator. In 1631 he obtained a fellowship at Sidney Sussex, and was collated to a prebend in the cathedral of Salisbury. He was next chosen rector of Broad Windsor, Dorset, and lecturer at the Savoy, London. In 1643, during the Civil War, he went to Oxford and joined the king; left in a few months for the army, in which he became chaplain to Sir Ralph Hopton, and employed his leisure in making collections of details concerning English history and antiquities. At the close of the war he took refuge in Exeter, and was appointed chaplain to the infant Princess Henrietta Anne. Shortly before the Restoration he was reinstated in his prebendal stall, and soon after that event was made one of the king's chaplains. Several of his writings are English classics, remarkable for quaintness of style, wit, sagacity, and learning. Among the more important are: *History of the Holy War*, *The Holy and Profane State*, *Pisgah Sight of Palestine*, *Church History of Britain*, and the *Worthies of England*, a production valuable alike for the solid information it affords about the provincial history of the country, and for the profusion of biographical anecdote and acute observation on men and manners.—Cf. J. E. Bailey, *The Life of Thomas Fuller*.

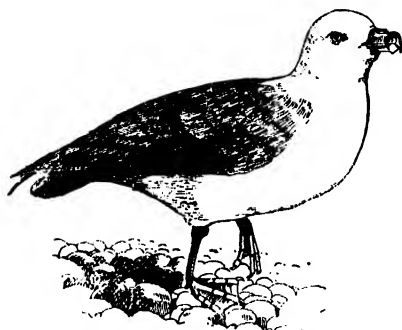
Fuller-Maitland, John Alexander, British musical critic, born in 1856. Educated at Westminster School and Trinity College, Cambridge, he was musical critic for *The Guardian*, *The Pall Mall Gazette*, and *The Times*. He edited the revised edition of Grove's *Dictionary of Music and Musicians* (1904-10), and wrote *Masters of German Music* (1894), *English Music in the 19th Century* (1902), and *The Age of Bach and Handel* (The Oxford History of Music).

Fuller's Earth, a variety of clay or marl, compact but friable, unctuous to the touch, and of various colours, usually with a shade of green. It is useful in scouring and cleansing cloth, as it absorbs the grease and oil used in preparing wool. It consists of some 60 per cent of silica with alumina and water, and the usual impurities of clays. Its properties are probably due to physical texture. There are extensive beds of this earth in southern English counties, and the name has been given to a stage in the Middle Jurassic series.

Fulling-mill, a mill used for fulling or felting woollen cloths; the modern name for such a mill is *milling-machine* (q.v.). An apparatus used for the same purpose and anterior to the milling-machine is known as *fulling-stocks*. The principal parts of this apparatus in its simplest form are the wheel and one or two projecting studs from its sides, which, while rotating, raise two levers, the ends of which are formed of large blocks of heavy wood, and shaped very much

like a pig's foot. The cloth to be fulled is saturated with soap and water, and placed in a suitably shaped receptacle into which the pig's-foot levers descend. The weight of the levers supplies the necessary pressure to the fabric, and at the same time their shape causes the fabric to roll gradually in the receptacle, so that all parts may be equally treated and fulled, i.e. made more compact. These simple stocks were subsequently replaced by more scientific stocks, which performed the same kind of action on the cloth but at a much higher speed.

Fulmar, an Arctic sea-bird (*Fulmarus glacialis*) of the family Procellariidae or petrels, about the size of a large duck. It inhabits the northern seas in prodigious numbers, breeding in Iceland, Greenland, Spitzbergen, the Shetland and Orkney Islands, and the Hebrides. It feeds



Fulmar (*Fulmarus glacialis*)

on fish, the blubber of whales, and any fat, putrid, floating substance that comes in its way. It makes its nest on sea-cliffs, and lays only one egg. The natives of St. Kilda value the eggs above those of any other bird. The fulmar is also valued for its feathers and down, and for the oil found in its stomach, which is one of the principal products of St. Kilda. When caught or assailed, it lightens itself by disgorging the oil from its stomach. There is a second and larger species (*F. pacificus*) found in the Pacific Ocean, and a third (*F. glacialisoides*) in the Antarctic.

Fulminic Acid, an acid known only in the form of its salts—mercury fulminate, $\text{Hg}(\text{CNO})_2$, and silver fulminate, $(\text{AgCNO})_2$, both of which are powerful detonators. See *Detonating Powders*.

Fulton, Robert, an American engineer, the introducer of steam navigation on American waters, was born in Pennsylvania in 1765, died 1815. He adopted the profession of portrait and landscape painter, and in his twenty-second year proceeded to England for the purpose of studying art under West. There he became

acquainted with the Duke of Bridgewater, Earl Stanhope, and James Watt, and was led to devote himself to mechanical engineering. In 1794 he took a patent for a double inclined plane, which was intended to supersede locks on canals; and he also patented a mill for sawing marble, machines for spinning flax and making ropes, and a dredging-machine. In 1797 he went to Paris, where he produced the first panorama that was exhibited there. He also, after some trials, was successful in introducing a boat propelled by steam upon the Seine. During a visit to Scotland he had seen and obtained drawings of the *Charlotte Dundas*, a steam-vessel which had plied with success on the Forth and Clyde Canal. His chief occupation in Paris, however, was the invention of torpedoes for naval warfare. He returned to America in 1806, and built a steam-boat of considerable dimensions, which began to navigate the Hudson River in 1807. Its progress through the water was at the rate of 5 miles an hour. In 1814 he constructed the first war steamship, and was engaged upon an improvement of his submarine torpedo when he died.—**BIBLIOGRAPHY:** C. D. Colden, *Life of Robert Fulton*; H. W. Dickinson, *Robert Fulton, Engineer and Artist: his Life and Work*.

Fu'mage (Lat. *fumus*, smoke), a tax on every house with a chimney, mentioned in *Domesday Book*, and commonly called smoke-furthings. It is supposed to have been the origin of the *hearth-money* imposed by Charles II, and repealed by 1 William and Mary, cap. x. Edward, the Black Prince, imposed a tax of one florin for every hearth in his French dominions.

Fumaria'ceæ, a small nat. ord. of Dicotyledons, closely allied to Papaveraceæ. The species are slender-stemmed, herbaceous plants, generally erect, though some climb by means of their twisting leaf-stalks. They are all astringent and acrid plants, and are reputed diaphoretics and aperients. They are found in the temperate and warm regions of the northern hemisphere and South Africa.

Fumigation is the application of vapours for the purpose of disinfecting rooms, clothing, bedding, and the like. For this purpose the most commonly used substances are: sulphur, either burned openly or in the form of sulphurous acid gas in cylinders; chlorine, generated from chlorinated lime; formaldehyde, commonly used as formalin. The efficiency of gaseous disinfectants is open to question, and certainly in the strengths usually in use they are not effective as germicidal agents.

Fumitory, the common name of *Fumaria*, a genus of plants, nat. ord. *Fumariaceæ*. Several species are known, natives of Europe and Asia, and two or three are found in Great Britain growing in dry fields and roadsides, and also fre-

quently in highly-cultivated gardens. They are slender annual herbs with much-divided leaves and purplish flowers in racemes at the top of the stem or opposite the leaves. *F. officinalis*, the best-known species, was at one time much used in medicine for scorbutic affections.

Fu-nan, the Chinese name for Camboja, from which they imported in the early part of the Christian era various products, including, as is stated, 'white pomegranates' and 'red pomegranates'. The 'white pomegranate' was especially prized, and supposed to contain the virtues of white jade. It was therefore called Yü liu. Yü is jade.

Funaria, a genus of mosses, one of which, *F. hygrometrica*, is common in Britain, especially on spots where a wood-fire has been, and grows in all parts of the world.

Funchal (fun-shál'), the capital of the Island of Madeira, situated on a bay on the south coast. It stretches for nearly a mile along the shore, and presents a thoroughly European appearance. It is a coaling-station for steamers, and is much resorted to by invalids afflicted with pulmonary complaints. Pop. 24,687.

Function, in mathematics, a quantity the value of which depends on the values of one or more other quantities. The area of a rectangle, e.g., is a function of its base and its height, or, definitely, $A = bh$. By the introduction of suitable units, any relation such as this between concrete quantities can be regarded as a relation between abstract numbers. In pure mathematics the quantities dealt with are therefore always purely numerical. In the equation $A = bh$, A , b , and h are called the variables, for they are capable of taking an unlimited number of values. The equation as it stands gives A in terms of b and h ; it gives an explicit answer to the question: what is the value of A when b and h are known? We say in this case that b and h are the *independent variables*, A being the *function* or *dependent variable*. It is obvious that the choice of a particular variable as the one which is *dependent* is to some extent arbitrary; we might, e.g., want the height of the rectangle when the base and area are given. We would then write the equation $h = A/b$, and h would be the dependent variable. When there are only two variables, it is usual to denote the independent variable by x , and the dependent variable by y , so that y is a function of x . The variety of functions is endless, but certain functions are much more important than others, owing to the simplicity of their properties, and the frequency with which they occur in nature. In the development of mathematical theory, these specially important functions occur in a fairly definite natural order, the properties of the simpler kinds being needed for the investiga-

tion of the kinds which are more complex. The chief functions of elementary mathematical analysis are:—

(1) The *polynomial*, or *rational integral algebraic function*,

$$y = a + bx + cx^2 + \dots + kx^n,$$

where n is a positive integer, and a, b, c, \dots, k are *constants*, that is to say, numbers which do not change as x varies.

(2) The *rational function*, any function which can be expressed as the quotient of one polynomial by another, as

$$y = \frac{2}{x^2 + x + 1} - \frac{x + 1}{x + 2}.$$

(3) The explicit *irrational algebraic function*, any function expressible in terms of roots of rational functions, as

$$y = \sqrt{x - 3} (x^2 + 2x + 4).$$

A function is said to be *explicit* when its value is directly given in terms of x , by an equation of the form $y =$ a certain expression in x . A function is *implicit* when the equation connecting x and y does not give y immediately in terms of x . If, e.g., $y^2 - 6xy + 8x^2 = 0$, y is an implicit function of x . In this case it happens that the equation can be solved, leading to $y = 4x$ or $y = 2x$, so that the implicit function is made up of the combination of two simple explicit functions. But in many important cases the equation in x and y cannot be solved so as to give y explicitly. A very important example of these cases is:

(4) The general *algebraic function*, a function y given by a rational integral equation containing x and y with their powers, as $x^5 + y^5 = 3xy + 1$. The theory of algebraic functions has been carried to a highly advanced stage, and is one of the most important branches of modern higher mathematics. Early writers divided all functions into two classes, *algebraic* and *transcendental*.

(5) The *exponential function*, $y = a^x$, and its inverse,

(6) the *logarithmic function*, $y = \log_a x$, where a is a positive number. These functions are said to be *inverse* to each other, because if $y = a^x$, then $x = \log_a y$, and conversely. Similarly the n th power and the n th root are inverse functions, for if $y = x^n$, then $x = \sqrt[n]{y}$. It is found that the properties of the exponential and logarithmic function take their simplest form when the number e (see *Exponential Theorem*) is taken as the base, the functions then being

$y = e^x$, and $y = \log_e x$. The outstanding results in the theory of these functions are that

$$e^x = 1 + x + \frac{x^2}{1 \cdot 2} + \frac{x^3}{1 \cdot 2 \cdot 3} + \dots \text{ and}$$

$$\log_e (1 + x) = x - \frac{1}{2}x^2 + \frac{1}{3}x^3 - \frac{1}{4}x^4 + \dots,$$

the series being infinite. The series for e^x holds for all values of x , but that for $\log_e (1 + x)$ does not converge unless x is a proper fraction, positive or negative, or $+1$.

(7) The direct circular functions, $y = \sin x$, $y = \cos x$, $y = \tan x$, with their reciprocals. Their simpler properties and relations are developed in elementary trigonometry. Of special interest are their *addition theorems*, e.g. $\sin(x + a) = \sin x \cos a + \cos x \sin a$. The functions can be expanded in infinite series of powers of x , either by algebraic methods as in higher trigonometry, or by Maclaurin's Theorem (q.v.) in the calculus. The series for $\sin x$ and $\cos x$ hold for all values of x . They are (x being in radians, as always in higher mathematics):

$$\sin x = x - \frac{x^3}{1 \cdot 2 \cdot 3} + \frac{x^5}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5} - \dots$$

$$\cos x = 1 - \frac{x^2}{1 \cdot 2} + \frac{x^4}{1 \cdot 2 \cdot 3 \cdot 4} - \dots$$

It follows from these series and that for e^x , given above, that $e^{ix} = \cos x + i \sin x$, and $e^{-ix} = \cos x - i \sin x$, where $i = \sqrt{-1}$. These relations between the exponential and the circular functions, involving the imaginary unit i , are typical of similar relations of far-reaching importance, the full development of which belongs to the *theory of functions of a complex variable*, a complex variable being a number of the type $x + iy$, where x, y are real, and i stands for $\sqrt{-1}$. The beauty and power of modern mathematics arise from this theory. Its simpler ideas are expounded in textbooks on higher trigonometry. More extended developments will be found in the treatises mentioned below.

(8) The *inverse circular functions*, $y = \sin^{-1}x$, $y = \cos^{-1}x$, $y = \tan^{-1}x$, &c.; now often written $y = \arcsin x$, $y = \arccos x$, &c. These are inverse to the direct circular functions, e.g. if $x = \sin y$, then $y = \sin^{-1}x$. For a given value of x between 1 and -1 , there are an infinite number of values of y which make $x = \sin y$; for definiteness, $\sin^{-1}x$ is conventionally defined to be that angle between $\frac{1}{2}\pi$ and $-\frac{1}{2}\pi$ whose sine is x ; $\tan^{-1}x$ is made to lie between these same limits, but $\cos^{-1}x$ between 0 and π . These functions also are expandible in series of powers of x of simple type. That for $\tan^{-1}x$ is the most

important; viz. if x is numerically not greater than 1, then

$$\tan^{-1}x = x - \frac{1}{3}x^3 + \frac{1}{5}x^5 - \dots$$

Putting $x = 1$, we get Gregory's series for π , viz.

$$\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots$$

The above list includes most of the functions usually discussed in elementary analysis. The *hyperbolic functions* may also be mentioned. They are defined in terms of the exponential function; thus $\cosh x = \frac{1}{2}(e^x + e^{-x})$, $\sinh x = \frac{1}{2}(e^x - e^{-x})$, $\tanh x = \sinh x / \cosh x$, &c. Their analogy with the ordinary circular functions is obvious from (7) above.

All the above functions are *analytic*; this means that for any value of x near a given value a (special values perhaps excepted), the function can be expanded in an ascending series of powers of $x - a$. Combinations of analytic functions, such as $\sin(\log \tan x)$ are analytic.

An important property of functions is their *continuity*. Speaking broadly, a function of x is continuous for a given value of x , when a small change in x produces only a small change in the function; but a much more precise definition is given in theoretical discussions. A function which has a derivative (see *Calculus*) is necessarily continuous, but the converse is not true; functions have been devised which are continuous for every value of x , and yet have no finite derivative for any value of x . An example is the function constructed by Weierstrass,

$$y = 1 + a \cos(\pi b x) + a^2 \cos(\pi b^2 x) + a^3 \cos(\pi b^3 x) + \dots,$$

where a is a positive proper fraction, and b is an odd integer such that ab is not too small, not less than 6, say.

In higher analysis, some of the chief functions which occur are:

(i) The *Gamma* (Γ) *function*, defined when x is positive by the integral $\int_0^\infty e^{-t} t^{x-1} dt$. An equivalent function, the Π function of Gauss, is sometimes used, $\Pi(x)$ being the same as $\Gamma(x + 1)$.

(ii) The *Beta function* of two variables x and y , given by

$$B(x, y) = \int_0^1 t^{x-1} (1-t)^{y-1} dt.$$

This function can be expressed in terms of Gamma functions. (See G. A. Gibson, *Treatise on the Calculus*.)

(iii) *Elliptic functions* (q.v.).

(iv) *Jacobi's Theta functions*. These are de-

finned by certain infinite trigonometrical series, and have remarkable properties. One of the four types is

$$\theta_3(z, q) = 1 + 2q \cos 2z + 2q^4 \cos 4z \\ + 2q^9 \cos 6z + \dots,$$

the indices of the powers of q being the squares of the natural numbers; the modulus of q must be less than 1 to ensure convergence. Elliptic functions can be expressed in terms of these θ functions. (See Whittaker and Watson, *Modern Analysis*.)

(v) Functions defined by differential equations (q.v.). For *periodic functions*, see *Fourier Series*. *Harmonic functions*, or *potential functions*, are functions which satisfy Laplace's equation (q.v.). *Green's functions* occur in the theory of Laplace's and other differential equations. — BIBLIOGRAPHY: G. A. Gibson, *Treatise on the Calculus*; E. W. Hobson, *Functions of Real Variables*; Whittaker and Watson, *Modern Analysis*; Harkness and Morley, *Theory of Analytic Functions*; A. R. Forsyth, *Theory of Functions of a Complex Variable*.

Fundi, or **Fun-dungl**, a kind of grain allied to millet (the *Paspalum exile*), much cultivated in the west of Africa. It is light and nutritious, and has been recommended for cultivation in Britain as food for invalids.

Funds, Public, and Funded Debt, money lent to the Government and constituting a national debt. These debts are distinguished as unfunded or floating when they are contracted to be paid off at a specified date; funded, when the interest only is paid, and the debt itself need never be paid at all. Funding a debt then means simply rendering it irredeemable, or redeemable only at the option of the borrower. Thus there are at present two kinds of funded debt in Great Britain—terminable annuities, in which the payment of interest for a given term of years, or for the life of the annuitant, extinguishes the debt; and permanent funds, upon which interest is due till the redemption of the debt, but in which no period is fixed for redemption. To this class belongs the great bulk of the National Debt (q.v.). A *sinking fund* is a fund or stock set apart, generally at certain intervals, for the reduction of a debt of a Government or corporation.

Fundy, Bay of, a large inlet of the Atlantic, on the east coast of North America, separating Nova Scotia from New Brunswick. At its inner extremity it divides into Chignecto Bay, and Minas Channel and Basin, with smaller continuations. It is noted for its impetuous tides, which cause a rise and fall of from 12 to 70 feet, and the navigation is dangerous. At its entrance are Grand Manan and other islands.

Fu'nen (Dan. *Fyen*), the largest of the Danish islands except Zealand, from which it is separated by the Great Belt, and from Jutland by the Little Belt; circuit, about 185 miles; area, 1132 sq. miles. The interior, towards the west, is covered by a range of low hills, but, with this exception, it is composed of large and fertile plains, under good cultivation. The largest stream is the Odense, which has a course of about 36 miles. The chief towns are Odense, Svendborg, and Nyborg. The pop. is 252,258.

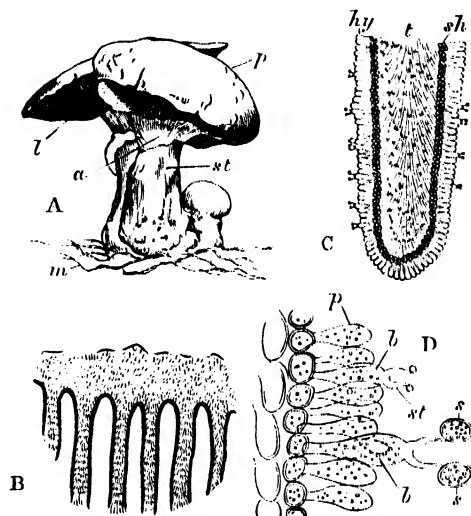
Funeral Rites, the rites and ceremonies connected with the disposing of the dead. Among the ancient Egyptians the friends of the deceased put on mourning, and abstained from gaiety and entertainments for from forty to seventy days, during which time the body was embalmed. (See *Embalming*.) Among the ancient Jews great regard was paid to a due performance of the rites of sepulture; and among the ancient Greeks and Romans to be deprived of the proper rites was considered the greatest misfortune that could happen. The decorous interring of the dead with religious ceremonies indicative of hopes of a resurrection is characteristic of all Christian nations. With Roman Catholics the body is the object of solemn ceremonial from the moment of death until interment. The Church of England funeral service is too well known to require any notice. Among other Protestant bodies there is usually no formal service, but before the interment prayer is offered up or an ordinary religious service held in the house of the deceased or his relatives, or, in the case of a public funeral, in some public place. The delivery of funeral orations by laymen is a common practice in France, and not infrequent in America. The wake, or watching, is celebrated in some parts of the United Kingdom, particularly in its remoter districts. In Ireland the wake of the lower classes is usually a scene of tumult and drunkenness. For many curious customs at funerals see Brand's *Popular Antiquities* and Strutt's *Manners and Customs*; see also *Burial*. — BIBLIOGRAPHY: Sir J. G. Frazer, *The Golden Bough*; E. B. Tylor, *Primitive Culture*; Sir J. Lubbock (Lord Avebury), *Origin of Civilization*.

Fünfkirchen (fünf'kirh-ën; 'Five Churches', supposed to be the Roman *Colonia Serbinum*), a free town of Hungary, on the slope of a hill, 105 miles s.s.w. of Budapest. It is the see of a bishop, and the cathedral, a handsome Gothic structure, is one of the oldest ecclesiastical edifices in Hungary. Fünfkirchen once had a flourishing university, attended by 2000 students. Its industries comprise the manufacture of fine pottery, woollens, leather, and liqueurs. In the neighbourhood brown coal and black marble are worked. Pop. 29,000.

Fungi (fun'ji), a very large division of cryptogamous or flowerless plants, comprising not only the different kinds of mushrooms and toadstools, but also a large number of minute parasites, such as mildews, rusts, and smuts, and also the various moulds, yeasts, dry-rot, &c. They agree with the Algae in being thallophytes, but differ in their mode of nutrition; they possess no chromatophores, and thus live either as saprophytes on dead organic matter, or as parasites at the expense of a living host. Most of the diseases of plants are due to the attacks of parasitic Fungi; but the useful work done by the saprophytic forms, as scavengers which prevent the accumulation of animal and vegetable debris, more than compensates for the destruction wrought by the parasitic species. Though many Fungi are edible, others are highly poisonous, and the importance of the whole class as a source of food is small. The plant-body of Fungi nearly always consists of a richly branched system of delicate filaments—septate in the higher groups, non-septate in the lower forms—called a *mycelium*; this form of thallus, combining large exposure of surface with great power of rapid penetration in all directions, is admirably suited to the needs of plants growing, as most Fungi do, in a solid organic medium. The reproductive organs of Fungi are various, but generally take the form of minute *spores* produced in incredible numbers and readily scattered by the wind; great quantities of the spores of the common species are always floating in the atmosphere, hence the inevitable appearance of moulds on stale bread or other suitable media if these are left exposed to the air and kept sufficiently moist. Sexual reproduction is prevalent among the more primitive types (Phycomycetes), but in the higher groups becomes reduced or altogether lost.

The classification of Fungi is attended by many difficulties, and the prevailing systems are necessarily more or less artificial. The principal subdivisions, with examples, are as follows: (1) *Phycomycetes*, or Lower Fungi.—Mycelium typically non-septate (or absent). Reproductive methods various. Sexual organs prevalent. Asexual spore often motile. Largely aquatic Fungi. Examples: *Chrysophlyctis endobiotica* (wart-disease of potato); *Phytophthora infestans* (potato-blight); *Mucor Mucedo* (common or black mould). (2) *Eumycetes*, or Higher Fungi.—Mycelium septate. Sexuality usually reduced or absent. Asexual spores never motile. Almost all terrestrial Fungi. There is one stereotyped form of principal reproductive organ, viz. either the *ascus*, a tubular sac containing eight *ascospores*, or the *basidium*, a club-shaped organ budding off four *basidiospores* from its upper end. Both ascospores and basidiospores are

carpospores formed as the result of a reduction division. (a) *Ascomycetes*.—Principal reproductive organ the ascus. Examples: *Sphaerotheca Castagnei* (hop-mildew); *Eurotium Aspergillus glaucus* and *Penicillium crustaceum* (common green and blue moulds); *Claviceps purpurea* (ergot of rye); *Dasyyscypha Willkommii* (larch-canker); *Morchella esculenta* (edible morel); *Saccharomyces cerevisiae* (beer-yeast). (b) *Basidiomycetes*.—Principal reproductive organ the basidium. Examples: *Ustilago Avenae* (oat-



Common Edible Mushroom

A, Group of mushrooms, two of which are full-grown, and one is still unopened; *m*, mycelium; *p*, pileus; *l*, lamellae; *a*, the veil; *st*, stipe. B, Section through the cap, showing gill-plates. C, Portion of a gill-plate, more highly magnified; *hy*, hymenium; *sh*, sub-hymenial layer; *t*, trama. D, Part of C, still more magnified, showing two basidia (*b*), one bearing basidiospores (*s*); *p*, paraphysis; *st*, sterigmata.

smut); *Puccinia graminis* (wheat-rust); *Polyporus betulinus* (birch-polyporus); *Merulius lacrymans* (dry-rot); *Agaricus campestris* (mushroom). (3) *Fungi Imperfecti*.—Fungi of which the complete life-cycle is not yet known; most of these are probably stages in the life-histories of Ascomycetes. Examples: *Fusarium Lycopersici* (sleeping-disease of tomato); *Helminthosporium gramineum* (stripe-disease of barley). Fungi abound in almost every part of the earth. They are rarest in deserts and in the polar regions; few marine species are known.—BIBLIOGRAPHY: De Bary, *Morphology and Physiology of the Fungi*; Marshall Ward, *Diseases of Plants*; Tubeuf, *Diseases of Plants*; Massce, *British Fungus Flora*; Eriksson, *Fungoid Diseases of Agricultural Plants*.

Fungicide, any substance used, usually in

the form of a spray, to combat the attacks of parasitic Fungi on cultivated plants. Among the best are Bordeaux mixture (slaked lime and copper sulphate), powdered sulphur, and Paris green (an arsenical compound).

Funkia, a genus of plants of the lily family, cultivated for the beauty of their large leaves and often lilac or white flowers.

Fur and Fur Trade. Fur is the fine soft hairy covering of certain animals, especially the winter covering of animals belonging to northern latitudes. The term fur is sometimes distinctively applied to such coverings when prepared for manufacture into articles of dress, while the name of peltry is given to them in an unprepared state or when merely dried. The animals chiefly sought after for the sake of their furs are the beaver, raccoon, musk-rat, squirrel, hare, rabbit, the chinchilla, bear (black, grey, and brown), otter, sea-otter, seal, wolf, wolverine or glutton, marten, ermine, lynx, coypou (nutria), polecat (fitch), opossum, and fox. Drying is the only preparation required by skins before being sent to the market. This prevents their putrefaction, and is effected by exposure to the heat of the sun or of a fire. The small skins are sometimes previously steeped in a solution of alum. When stored in large quantities, they must be carefully preserved from dampness, as well as from moths. The fur-dresser, on receiving a skin, first subjects it to a softening process. He next cleans its under-surface from loose pieces of the integument by scraping it with an iron blade. Finally, the fur is cleaned and combed, after which the skin is ready to be cut into any required shape.

Furs for Europe were formerly supplied largely by Russia, which produces a great quantity, especially in the Asiatic portion of her territory. Austria, Turkey, and Scandinavia also yield a certain quantity. The fur trade of America has long been highly important, and several great trading companies have engaged in it, of which the Dutch East India Company was first. The French early took up the fur trade in Canada, and their chain of forts and trading-posts at one time extended from Hudson Bay to New Orleans. Quebec and Montreal were at first trading-posts. In 1670 Charles II granted to Prince Rupert and others a charter empowering them to trade exclusively with the aborigines of the Hudson Bay region. A company, then and after called the *Company of Adventurers of England trading into Hudson Bay*, was formed, which for a period of nearly two centuries possessed a monopoly of the fur trade in the vast tract of country known as the Hudson Bay Territory. In the winter of 1783-4 another company was formed at Montreal, called the *North-west Fur Company*, which disputed the right of the Hudson Bay Company, and actively

opposed it. After a long and bitter rivalry the two companies united in 1821, retaining the older name. The monopoly which had hitherto been enjoyed by the original company about Hudson Bay was now much extended; but in 1868 an Act of Parliament was passed to make provision for the surrender, upon certain terms, of all the territories belonging to the company, and for their incorporation with the Dominion of Canada. In 1869 the surrender was carried out, Canada paying £300,000 to the company by way of compensation. The company still possesses large stretches of valuable land, and many houses, forts, and posts in the region formerly belonging to it. Its operations have even extended beyond British America into the United States and to the Sandwich Isles and Alaska. It employs a large staff of agents, traders, and Indian hunters. Some of its posts are situated far north, almost approaching the Arctic Ocean. The trade in furs conducted by citizens of the United States has been extensive, but in a greater degree the result of individual enterprise than of the management of gigantic corporations. The Alaska Fur Company holds two of the Aleutian Islands in lease from the United States Government with the sole right of killing yearly not more than 100,000 furs. The two great European centres to which furs are brought are London and Leipzig.

Furca, or **Furcahorn**, an Alpine mountain in Switzerland, canton of Valais, immediately west of St. Gothard; height, 9935 feet, containing the glacier in which the Rhône has its source. The summit of the Furca Pass, over which there is a good road, is 7992 feet high.

Furcraea, a genus of plants, ord. Amaryllidaceae, closely allied to Agave; some species yield a fibre known as Mauritius hemp.

Furies (Gr. *Eumenides* or *Erinnyes*, Lat. *Furiae* or *Diae*), goddesses who were originally personifications of the curses pronounced upon guilty criminals. Different ages looked upon these goddesses in different ways. The name Erinnyes means 'goddesses who hunt', while Eumenides was a euphemistic expression, meaning 'kindly ones'. At Athens they were sometimes also called Semnai or 'venerable ones'. The crimes which they punished were failing to honour father and mother, perjury, murder, and violation of the laws of hospitality or of the rights of suppliants. They were supposed to be able to destroy all peace of mind, and to make their victim either childless or unfortunate in his children. In the *Eumenides*, the concluding play of the *Oresteia* of Aeschylus, the poet brought a chorus of twelve furies upon the stage. This magnificently conceived play describes the reconciliation between the older gods and the newer ones, and ends with the Furies

FUNGI



Stag's Horn (*Xylaria*)



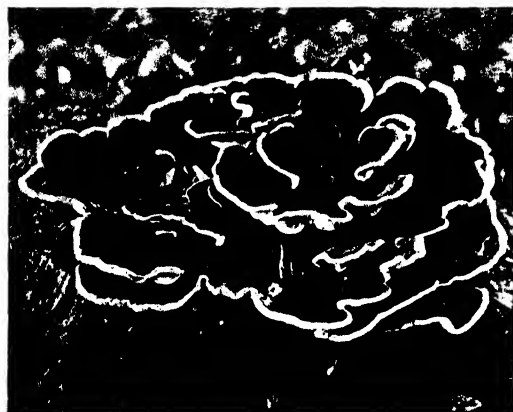
Club-tuft (*Clavaria*)



Honey Toadstool (*Armillaria*)



Orange Cup (*Peziza*)



Shelf Fungus (*Polystictus*)

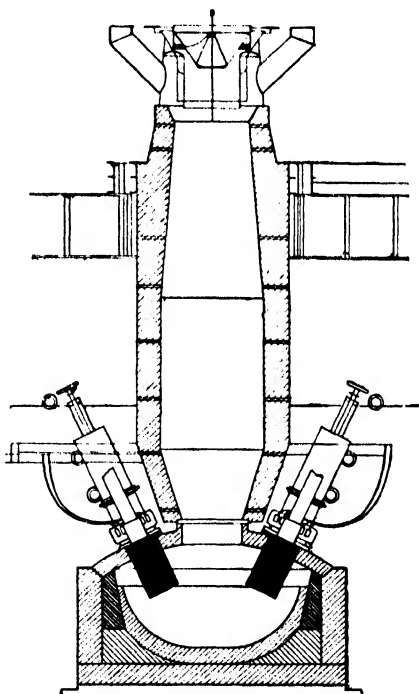


Earth-star (*Geaster*)

consenting to share a sanctuary with Athene. *Æschylus* describes them as being dressed in black, having serpents in their hair, and blood oozing from their eyes. Some later writers limit their number to three, and give them the names of *Tisiphone*, *Alecto*, and *Megaira*. The sacrifices offered to them consisted of black sheep and a mixture of honey and water. No wine was offered.

Furnace, a chamber or structure arranged for the utilization of heat generated by the combustion of fuel or by means of an electric current. The word is also sometimes used in a more general sense for combustion chambers, for example, in connection with boilers, arrangements for house heating, baking pottery or bread, but is more particularly used for the structures arranged for the smelting of ores or for the melting or heat treatment of metal. In the construction of furnaces the following objects are kept in view: (1) to obtain the greatest quantity of heat from a given quantity of fuel; (2) to prevent the dissipation of heat after it is produced; (3) to concentrate the heat and direct it as much as possible to the substance to be acted upon; (4) to be able to regulate at pleasure the necessary degree of heat, and have it wholly under the operator's control. Furnaces vary considerably in design, according to the nature of the operation to be carried out in them, and according to the nature of the fuel to be used. They may be arranged for the combustion of solid fuels such as wood, charcoal, coal, coke, or anthracite; for liquid fuels such as crude natural oils, distilled oils, tar, &c.; or for gaseous fuel such as coal-gas, producer-gas, waste furnace-gas, &c. In special cases they are arranged for the utilization of electrical energy by means of induction, resistance, and the arc. The method of applying the heat generated to the work in hand varies considerably, and may consist of direct heating, where the material comes into direct contact with the solid fuel, as in the case of a smith's hearth, and also in the case of blast-furnaces, in which ore and the fuel are charged into one chamber. Direct heating may consist of the flame or products of combustion only coming in contact with the material, as in reverberatory furnaces, in which the fuel is burnt in a separate part or chamber and the flames reverberate from the roof over the material. Indirect heating is utilized in those cases in which crucibles are used, or in which it is desirable to keep the material out of contact with the solid fuel and the products of combustion. In these cases the heating is carried out by conduction or radiation through the walls of the containing vessel, as in crucible-, muffle-, and retort-furnaces. Furnaces are generally

classified according to their form or design, and although not strictly speaking furnaces, *heaps* and *piles* may be considered as the simplest form, as these undoubtedly constituted the oldest form of heating arrangement. These forms are still used to some extent for the preparation of charcoal and coke, in which a portion of the charge itself is burnt to generate the heat; they are also used for the calcination and roasting of certain ores. For this purpose



Electric Iron-ore Reduction Furnace at Trollhättan

Four electrodes; two-phase current at 50-90 volts; consumption 2300 kilowatt-hours per ton of pig-iron produced from magnetite ore averaging 60 per cent iron.

the material is mixed with the necessary fuel and piled up, passages being left for the purposes of draught.

A *stall* is an improvement on the open heap, and generally consists of a rectangular space surrounded on three sides by brick walls, the top and front being left open. In some cases flues and chimneys are arranged in the walls for the regulation of the draught. These structures were formerly used for the preparation of coke, and are now used for calcining ores, burning lime, &c. The material is charged into the space together with layers of fuel as required, and the front is bricked up as the filling proceeds. This structure offers a certain protection from

the weather, and ensures more uniform combustion.

Shaft-furnaces consist of vertical walls, either circular or rectangular in cross-section, in which the height is several times the diameter or length of the narrower side. The material is charged in at the top, and the product removed from the bottom either in the solid or liquid form. The fuel used in shaft-furnaces is usually solid, and is mixed with the charge to be treated or added in separate layers during the charging. Oil or gas is sometimes used as fuel in these furnaces, and recently powdered coal has also been used, these fuels being injected at the bottom of the shaft. The air necessary for the combustion of the fuel is admitted at the bottom, either by natural draught or under pressure, through suitably placed tuyeres.

Shaft-furnaces may be conveniently subdivided into three classes, viz. kilns, cupolas, and blast-furnaces. Kilns are relatively short and wide, and are chiefly used for calcining ore, limestone, &c., during which operations a very high temperature is not required, the burnt product being removed in the solid state. Cupolas are also relatively low furnaces, circular in shape, with a small diameter. They are used for the melting of pig-iron in foundry practice and in Bessemer steel plants. The fuel used is coke, and low-pressure blast is admitted. The bottom of the furnace, where the molten iron accumulates, is called the hearth or well, and is provided with tap-holes for the withdrawal of the iron and slag. The bottom of these furnaces is usually closed with a hinged plate of cast iron, which can be lowered to empty the cupola after a run.

Blast-furnaces are shaft-furnaces in which ores and metallurgical products are smelted with high-pressure blast, and the products, consisting of metal or metalliferous substance with slag, are tapped out in the liquid state.

Reverberatory furnaces are those in which the material to be heated or smelted is charged into one part of the furnace, known as the hearth or laboratory, separated from the part in which the fuel is burnt, known as the fire-place. The necessary heat is obtained from the products of combustion of the coal, oil, or gas used as fuel.

Reverberatory furnaces are frequently fitted with arrangements for the utilization of the heat of the waste gases. When the air required in the furnaces is passed through pipes around which the hot waste gas from the furnace is passed, it is known as a recuperative furnace, or a furnace worked on the counter-current system. When the hot waste gases are made to heat large chambers filled with chequer brickwork on their way to the chimney, the heat stored up in these chambers being subsequently used to

pre-heat the air, or air and gas, used in the furnace, it is known as a regenerative furnace. This type of furnace is largely used in the manufacture of steel (Siemens furnace), in zinc retorts, &c.

Crucible furnaces are those in which the material to be treated is contained in crucibles, which are vessels made of fire-clay, plumbago, &c. The crucibles may be heated by being embedded in solid fuel such as coke, which is burnt in a short shaft-furnace arranged with fire-bars at the bottom. These furnaces, known as wind- or pot-furnaces, are frequently sunk below ground-level to facilitate the charging and removal of the crucibles. Similar furnaces are arranged for gaseous firing, and may be fitted with regenerators.

Muffle-furnaces are arranged for the heating of charges out of contact with the fuel or products of combustion. They are largely used for the roasting of sulphide ores, when it is desirable to obtain a gas rich in sulphur dioxide for the manufacture of sulphuric acid. Muffle-furnaces are also used for the heating of various metals, for example, copper, and as heating furnaces for steel-hardening processes.

Retort-furnaces are similar to muffle-furnaces and gas-retorts, and are used in the metallurgy of zinc, and for the extraction of arsenic. A continuous furnace is one in which the material is charged at one end and withdrawn at the other end, charging and withdrawal taking place continuously. This type of furnace is used in the roasting of sulphide ores, and when the charge is moved along by means of rakes worked by machinery, it is known as a mechanical furnace. Continuous heating furnaces are also much used for the heating of ingots in the forge. These are arranged so that the ingots may be charged cold at the flue end, and moved slowly down to the withdrawal door on water-cooled pipes by hydraulic pushers. On reaching the door at the fire-place end the billets should have acquired the temperature necessary for the operation. See *Blast-furnace*; *Electro-metallurgy*.

Furieux Islands (fēr'niō), also called **Flinders**, a group belonging to Tasmania, at the east end of Bass Strait, Flinders Island being the largest. The inhabitants, who number about 600, procure a living by seal-fishing and preserving mutton-birds, a species of petrel. The islands are named after Tobias Furneaux, the officer who was second in command in Captain Cook's second voyage (1773).

Furnes (fūr'n, Fl. *Veurne*), a town in Belgium, not far from the North Sea and the French frontier, at the junction of several canals. It has two ancient churches and an interesting town hall. In early times Furnes was an important stronghold. It was bombarded by the

Germans 24th-27th Oct., 1914. In 1920 it received the Croix de Guerre. Pop. 6000.

Furness, a district of N.W. Lancashire, forming part of what is called the Lake District. Furness Abbey is a noble ruin situated 1 mile s. of Dalton-in-Furness, comprising the church walls, chapter-house, refectory, and guest hall, the whole giving evidence of the former magnificence of the structure. It was founded in 1127 by Stephen, afterwards King of England.

Furniss, Harry, British caricaturist, author, and lecturer, born at Wexford in 1854, died 1925. He came to London at the age of nineteen, and began to contribute drawings and sketches of a humorous character to the principal illustrated papers. In 1884 he joined the staff of *Punch*, and became one of its most popular illustrators. He invented the legendary Gladstone collar which made him famous, and illustrated the works of Dickens (1910) and Thackeray (1911). In 1894 he left *Punch* and started a weekly paper of his own, *Lika Joko*. An admirable lecturer, he lectured in Great Britain, the United States, Australia, and Canada on the *Humours of Parliament*. His works include: *Confessions of a Caricaturist* (1901), *Harry Furniss at Home* (1903), *How to draw in Pen and Ink* (1903), besides novels and plays for the cinematograph.

Furniture. Furniture indicates the intimate habits of the user, and its study enables the student to gauge the plane on which the men who made it stood. The historian includes social habits and concomitant details in his exposition of the past. Hence the study of the domestic furniture of man and its evolution is parallel with the study of his social progress throughout the various epochs. In general, great art conceptions, whether in architecture, painting, or furniture, were contemporaneous with a great productive period in literature. The Renaissance in art, which began at Florence in the fourteenth century, was at first a literary movement. Art has always been the handmaid of literature, and applied art, such as the fashioning of furniture, is a mirror held to the social culture of a nation.

In a review of ancient furniture, Egypt, as the oldest known civilization, takes a foremost place. The survival of so many examples of furniture is due to the preservative properties of an excessively dry climate, and in addition papyri and mural paintings have depicted furniture and its use. Ancient Egyptian furniture was painted, inlaid with fine woods or ivory or glass, and sometimes plated with gold. It is of great antiquity; there is a wooden coffin of Men-kau-ra, a king of the fourth dynasty, about 3633 B.C., at the British Museum. From what is known of early Egyptian furniture, the craftsmen must have possessed hammers, chisels,

axes, gouges, awls, and possibly some form of lathe. Egyptian furniture is solid in construction, with garish Eastern colouring. The human figure was used, and animal forms with limitations. Sphinxes as supports and terminal ornaments, and animal feet to chairs and couches are prototypes which descended to later schools. Coffers, caskets, couches with sphinx supports (reproduced under the First Empire period of Napoleon), folding stools, and dolls and toys are preserved, including a crocodile with moving jaw. The principal collections of Egyptian furniture are in the British Museum, the Louvre, Paris, the Leyden Museum, the Berlin Museum, and the museum at Cairo.

Of Babylonian furniture, and of the subsequent Assyrian epoch, few remains exist. The forms are mostly recorded in the sculpture of the period. The Babylonians were the creators as artists and the Assyrians the conquerors; the parallel holds good in relation to the Romans, who similarly appropriated the arts of the Greeks whom they governed. At the British Museum there is a plaster cast of Gudea, a king of Babylon about 2500 B.C., and an Assyrian bronze throne shows feet of animal form as in earlier Egyptian design. An Assyrian throne (circa 880 B.C.) has rams' heads as terminals. This ornamentation was used later by the Romans, and also by the Adam brothers in the eighteenth century. The Bible has many references to Jewish furniture, but Judæan work was largely derivative from Egypt and Assyria, and nothing is preserved, although there is the golden candlestick with its seven branches from the temple at Jerusalem, carried away as spoil by the Romans, and shown in the carving on the Arch of Titus at Rome.

Greek furniture is mainly known from sculpture. Seated figures, six centuries before Christ, at the British Museum, show the form of chair then in use, with mortises and tenons accurately reproduced in the marble. Drawing upon other earlier sources, the Greeks evolved a distinct type of furniture, from which succeeding ages have adapted many designs. Simplicity of outline marks the period. The great period of Greek art began in the fifth century, and lasted over two hundred years. The chairs can be adjusted to many angles; modern designers have found inspiration in these ancient models. The chairs of the Empire period of the early nineteenth century were duplicates of these sculptured prototypes, and the arch for the back, a noticeable feature, has become permanent in modern chairs designed for comfort. The chair of Poseidippos, the writer of comedies, first half of third century before Christ, in the Vatican, appears to be quite as comfortable as the modern library chair.

The excavations at Herculaneum and Pompeii in

the eighteenth century enabled the Roman house with its domestic furniture to be reconstructed. The Naples Museum shows many examples of bronze furniture exhibiting winged sphinxes, and lion supports to tables, and elaborate ornament with wreaths, and the predominant feature of the animal foot. Couches in bronze have turned ornaments. (The same style reappeared in Stuart days in brass candlesticks and in turned walnut legs to chairs.) In Roman furniture there was an amplification of ornament supplanting the beauty and simplicity of the Greek design. The materials employed were gold, silver, bronze, ivory, marble, and wood, and these were decorated by curving, damascening, veneering with coloured woods, or inlaying with precious stones. The peculiar markings of veneer had names such as *tigrinus*, resembling a tiger, and *apiatus*, like a swarm of bees. Tortoiseshell was used, and horn was stained, thus anticipating Boule, the great French cabinet-maker, by many centuries.

After the seat of empire was removed from Rome, the Byzantine style arose in Constantinople, from A.D. 321 till about 1204. Of thirteenth-century work is the Coronation chair made for Edward I, now at Westminster Abbey. The carved lions supporting this chair are modern, and were regilded at the time of Queen Victoria's jubilee in 1887. It was during the thirteenth and fourteenth centuries that mediæval art in Europe reached its zenith. But the fineness of Gothic wood-carving did not touch England till after its adoption on the Continent. At the Cluny Museum, Paris, a rich collection of Gothic coffers of the fifteenth and sixteenth century is exhibited, and one example of the end of the thirteenth century is noticeable for its finely carved panels. At the Landesmuseum, Zurich, a representative series of old Swiss chests shows fifteenth and sixteenth century types based on German work. Some of the sixteenth-century chests are Italianate in character. At St. Saviour's Church, Southwark, is a fine chest of the sixteenth century, inlaid with marquetry. In Holland the chest was made of oak, walnut, *lignum-vitæ*, or some other wood imported from the Dutch East Indies. The *kas* was the receptacle for household linen, and the great *kasten* was mounted on wooden ball feet, the prototype of the modern wardrobe.

In England the great effects of the Renaissance in art were derived from the Continent. The change from Gothic or Mediæval work to the classic styles of ancient Greece and Rome had its origin in Italy. The early Tudor days under Henry VII saw the dawn of the Renaissance in England. Renaissance art made a change in architecture, and a corresponding change took place in furniture. Foreign workmen were em-

ployed by the Church and by the nobility in embellishing cathedrals and churches and feudal castles. Flemish woodworkers settled in England, and the harmonious blending of the designs of the Italian and Flemish schools resulted in the growth in England of the style known as Tudor. A comparison of the examples of Italian Renaissance of the fourteenth and fifteenth centuries with Elizabethan and domestic furniture shows the guiding influence. In general details of technique the English styles have a close affinity with the art of the Netherlands as derived from Italy. The spiral turned legs and columns, the strap frets cut out and applied to the various parts, are outstanding features. As a chronological record of details of technique, it may be recorded that in the reign of Henry VII (1485-1509) hutches (the old term for cupboards), credences (tasting-tables; It. *credenza*, a shelf or buffet), and panelled or box chairs all showed Gothic motives in their arches or tracery. Linen-fold panelling remained till 1550, that is, throughout the reign of Henry VIII. About this date Gothic designs disappeared until revived by Chippendale and others in the middle of the eighteenth century. Oak was the main wood used in all Tudor and early Stuart furniture. In the reign of Edward VI inlay was first used in England to decorate furniture, and chests with drawers came into use, but not general use. Elizabethan furniture is rich in elaborate and massive carving. Caryatides (female figures used as supports), and Atlantes (male figures of similar use), and grotesque masks are features in the massive decoration of tables and bedsteads. Bulbous legs to tables are noticeable, and strap-work, found also in the silver of the period, is prominent. Inlay of coloured woods was popular, though there is a coarseness in its use not comparable with contemporary Italian and Continental examples. Inlays representing buildings, a feeble echo of fine Italian marquetry, such as the Nonesuch chest (a representation of Nonesuch House, one of Elizabeth's seats), were very popular. Panelled-back chairs were introduced with a cresting (cresting is a term applied to the ornamental work which finishes the upper part, as in a chair back). In the reign of James I furniture underwent little change, although he is the monarch who gave the term Jacobean to English styles prevalent mainly in later reigns. In general there was a leaning to tapestry. The Mortlake tapestry factory was founded about 1620, and upholstered chairs and stools were made for noble families. Wooden seats had hitherto been considered as sufficient. Sir John Harrington, writing in 1597, asserts that "the fashion of cushioned chayrs is taken up in every merchant's house". Leather seats and backs of finely tooled work richly gilded had been imported

from Spain. The insanitary rush floor had been superseded by wood, and carpets came into general use in Elizabeth's day. Even pillows, deemed by the hardy yeomanry as only fit "for women in child-bed", found a place in the elaborately carved Tudor bedstead.

The Stuart or Jacobean styles are varied. The term Jacobean includes the reigns of James I (1603-25), Charles I (1625-49), the Commonwealth period (1649-60), and the reign of Charles II (1660-85), James II, and William and Mary (ending in 1702). Practically a century covers various types, commencing with the continuance of oak, and embracing the adoption of walnut and the beginning of elaborate and nearly modern styles.

In the reign of Charles I chests with drawers became popular, and applied baluster ornament was frequently used in them. Spiral twists for chairs were first used about 1635, and at the same time flap tables with folding legs, which later developed into elaborate gate-leg tables, were introduced. In Charles's reign leather-backed and seated chairs, studded with brass nails, were noticeable. These are most frequently termed Cromwellian chairs, but they originated in or about 1645. During the Civil War little furniture was made. Under Puritan influence the carved representation of the human figure disappeared. Iconoclasts abominated the style, and it was as much anathema as it was to the Mohammedans, who never used the human figure in their carving, but resorted to geometric design, as exhibited in Hispano-Moresque work at the Alhambra and elsewhere. Table settles and table chairs, a mechanical combination, were introduced under the Commonwealth, but there is little else to record in furniture. Under Charles II and his brother James II quite a variety of fashions came uppermost. The pendulum swung from sobriety to licence, and a great stimulus was given to inventiveness and originality in design. Moreover, some of the Royalists who had been forced to fly the country introduced new ideas from the Continent.

The first introduction of caned backs and seats took place in the reign of King Charles II, when the heavy wood framing and carving of the earlier styles was still very pronounced. Under James II the wood ornament gave place to lighter caning more freely used, and to padded or upholstered seats. Chairs with upholstered wings and arms came into use about 1685. Under William and Mary walnut became dominant, and in consequence greater freedom was possible in fashioning the softer wood. Elaborate scrolls and carved splats were frequent. Fiddle-splats and serpentine stretchers to chairs, and cabriole legs and ball feet, came into England under Dutch influence. Marquetry was

introduced from Holland, and a pattern known as 'sea-weed' is noticeable in cabinets and clock-cases. Grandfather clocks came into general use about 1700, and tall-boy chests of drawers appeared at the same time, and continued for over a hundred years in constant fashion. Lacquer furniture, also an importation from Holland, became the vogue, and continued through later reigns. It is the most un-English of all classes of furniture, but it had a vogue in the eighteenth century, and has of late years been unaccountably revived. The reign of Queen Anne is indubitably the age when walnut was supreme. Her reign actually was from 1702 to 1714, but the term 'Queen Anne' is applied to furniture made before and after this period. It is somewhat generic. This period is one of solid and sober workmanship. Club feet are noticeable in the chairs; shell and pendant ornament on knees of cabriole legs came into use. The cabriole leg had established itself until Chippendale replaced it with his straight leg in Chinese manner. Certain tall cabinets with drop-down fronts with nests of drawers are associated with this period, and the arched pediments in architectural form. This style has been largely duplicated by modern cabinet-makers. The reigns of the first two Georges ended in 1700. As an approximate half-century, the period offers interesting points till the rise of Chippendale. Various factors appeared before Thomas Chippendale seized the results and made them his own. The eagle's head ornament in 1714 lasted some twenty-five years. The shell ornament became established in the following years. In 1720 the lion's mask ornament and lion's paw feet became fashionable for some fifteen years. In 1725 mahogany was a favourite wood, and, being softer than walnut, was capable of finer design. Splats of chairs began to be pierced; top-rails of chairs and settees became hooped with carved crestings. The duty was removed from mahogany in 1733, and from that date the great Mahogany period began. The silver designs of the George II period should be studied with those of the furniture. French influence was strong, both upon the metal-worker and the cabinet-maker. The great epoch of Louis XIV had a decided influence in England.

Books of designs were published by English cabinet-makers which showed derivative influences, such as those of William Jones (1739) and William Kent (1743), and Ince and Mayhew's *Household Furniture* (1748). Rapidly innovation succeeded innovation; the Chinese taste in lacquer panels showed colour in competition with form. Chinese geometric ornament and pagoda pediments came uppermost. The Gothic style also had a vogue. In 1750 ribbon-back chairs, a derivation from French models, came into popular use. In 1753 Chippendale was busy in his work-

shops at St. Martin's Lane focussing all these styles and forming his own eclectic one. In 1754 he published the first edition of his *Gentleman and Cabinet Maker's Director*. Ladder-back chairs at this date were made, and straight-legged chairs came into fashion. On the return of Sir William Chambers, the architect, from China, the Chinese style gained further publicity. Lattice-work, fretwork, and applied fret were in constant use. Chinese lanterns in mahogany hung in noblemen's mansions. In 1757 Chambers published his *Designs of Chinese Buildings, Furniture, Dresses, Machines, and Utensils*, and he built the pagoda at Kew. But contemporaneous with this movement, and almost antagonistic to it, came the Classic revival. Wedgwood in Staffordshire was producing his gods and goddesses in pottery. Roman and Greek cameo designs were applied to furniture. Robert Adam, the Scotsman, one of three brothers, had returned from Italy to revolutionize the arts of furnishing and of architecture. It was in vain that Ince and Mayhew, in 1762, published an echo of other styles, and Chippendale came out with his third edition of the *Director* in 1762. Robert Adam was appointed architect to the king, and the great classic revival began. Chippendale unfortunately reverted to Gothic banalities, and produced some of his worst work, although collectors still give great prices for this. But about 1770 Chinese styles went out of favour and Gothic became less fashionable. In 1768 Matthias Lock had published several books on furniture, but nothing of importance appeared to influence the main stream of design. At the same date certain chairs with straight top-rails were designed by Adam and executed by Chippendale. The two schools here merged, and records go to show that Adam and Chippendale worked together in design and execution. The firm Thomas Chippendale & Co., or Chippendale and Haig, executed cabinet-work where marquetry was one of the important features. The divergence of Chippendale from his original and brilliant conceptions, where ornament was dependent on form, to his later period, where he accepted the newer dicta that ornament might gain from colour, is interesting, and shows his extraordinary versatility.

With the promulgation of his *Director* Chippendale made a style that was copied by cabinet-makers throughout the country. There is cottage Chippendale made by village joiners, where in elm and yew and beech and sycamore his models were carried out with native touches of delightful originality. Such work is eagerly bought by collectors. In Ireland there was a school which imitated in mahogany some of Chippendale's designs. This work is heavy, and very readily distinguishable from Chippendale's prototypes.

As a masterly adapter Chippendale stands supreme. His ball-and-claw feet and his spacious seats he borrowed from the Dutch, or from earlier Georgian furniture under Dutch influence. He translated the heavy walnut splats of early Georgian days into terms of mahogany. He realized how much of the Louis XIV ornament was suitable to English domestic furniture. In his ribbon-back chairs he assimilated the flowing ornament of the Louis XVI period. But his adaptations became original under his hand, and, tempered by French subtleties, they are robust and sturdy. His Chinese fretwork in the angles of his chairs and tables was in obedience to the Chinese taste. But symmetry was Chippendale's own gift. He knew to a nicety how much ornament a structure would bear. The splats in his chairs are of such graceful and perfect dimensions, in proportion to the open spaces, that no would-be imitator was able to copy them. He was the prince of chair designers; and for the first time in the history of English furniture Continental designers turned their eyes to this country in admiration of the new styles being produced.

Up to the days of Thomas Chippendale, whether it be the age of oak or the age of walnut, the terms Tudor, Jacobean or Stuart, Anglo-Dutch (under William and Mary), Anne, or early Georgian are names applied by modern connoisseurs to various styles. After Chippendale furniture began to be classified by the particular designers or makers. For half a century the styles of Chippendale held sway, from 1730 to 1780. The Hepplewhite school may be said to reckon from about 1775 to 1795, and the Sheraton designs covered a period from about 1790 to 1805, and behind all there was the paramount classic influence of the brothers Adam, with their absorption of classicism and forms coincident with the later French styles beginning to become chaste and severe.

It is impossible to put aside the contemporaneous influences the great French cabinet-makers had upon design, under the four great periods Louis XIV, Louis XV, and Louis XVI, followed by the great classic revival known as the First Empire period. In a measure this cannot be said to be domestic furniture. It had an architectural outlook. It was designed as a factor in certain schemes of decoration of sumptuous palaces. Removed from Fontainebleau and Versailles, such pieces of grandiloquent art as are exhibited at the Wallace Collection and elsewhere are jewels torn from their settings. But as an influence such unparalleled mastery of technique has found no equal in any other country. André Charles Boule (1642-1732), succeeded by his four sons, founded an *atelier*, and under Louis XIV introduced his splendour of

veneered work in ebony inlaid with tortoiseshell and brass, set in massive metal mounts. The *Louis Quatorze* period extends from the days of Charles I to the reign of Anne. The *Louis Quinze* style (1715-74) is represented by commodes with chased and bronzed gilt mounts by Caffieri, when the cabriole leg and swirling forms of ornament were pronounced. The chaster cabinet-work of Riesener is found in the *Louis XVI* period, when the style became more restrained, and in France the style of Sheraton is termed *Louis Seize à l'Anglaise*.

In middle and late eighteenth-century days books of designs by London cabinet-makers were published for the use of the trade. They served to consolidate styles and promulgate ideas to lesser men. In 1788 Hepplewhite published his contribution to the literature. The grace and beauty of form is a noticeable feature of the Hepplewhite style. The wheat-ear on chair backs is a favourite design which has stood the test of time. An examination of the Hepplewhite volume, *The Cabinet-Maker and Upholsterer's Guide, or Repository of Designs for Every Article of Household Furniture, from Drawings by A. Hepplewhite & Co., Cabinet-Makers* (1788), shows the clarity of Hepplewhite's interpretation. He stood between Chippendale's magnificent impossibilities and Sheraton's seizure of form embellished with colour. In a measure Hepplewhite is the golden mean between two opposite schools. He leaned to form, but he essayed efforts in colour, as in satin-wood with painted panels.

Sheraton was not a practical master cabinet-maker. He was a designer. He came to London as a journeyman cabinet-maker. He opened a stationer's shop in Soho, and became in turn Baptist preacher, author, and teacher of drawing, all these occupations being equally unremunerative. His is a name which posterity recognizes as the founder of a school, derivative though it may have been.

A deep-rooted idea seized France at the Revolution that the modern Republic should emulate the fame of Athens and of Rome. The First Consul appeared with a laurel wreath around his head, posing as Cæsar. This style, which threw aside all the characteristics of former periods, came to be known as the First Empire. At Malmaison and at Fontainebleau there are many examples. The influence on English furniture lasted up to the first quarter of the nineteenth century. A later style, which has been termed the Regency, as being associated with the period from 1811 when the Prince of Wales was appointed regent when George III became insane, may really be merged with the George IV period (1820-30) and the William IV period to 1837. During these years a decadence set in. With

the declining classic modes, the transition into the banalities of the hooped-back Windsor chair, and the ineptitudes of cabriole legs with upholstered seats, there lingered certain forms of chair with curved back of quasi-classic form, where fine brass inlay in floral design was introduced with fine effect. Many of these chairs were made in the eastern counties till up to a later date.

During the Early- and Mid-Victorian period (from 1837 up to 1887) furniture showed no signs of continuing its great traditions. When sumptuous pieces were made, they were so overloaded with ornament as to be repulsive. The same applies to Victorian silver-plate. The period was poor in inventive design, and it was not until the 'eighties that artistic impulses were stirred, under the guidance of William Morris and others, to revert to simpler and more beautiful forms. Old furniture was preserved, and collecting it became a common hobby. The public taste has been educated mainly by colonies of artists who have striven to influence trade productions. Gate-leg tables, simple farmhouse chairs in yew, with fiddle-splats or wheel-backs, graced many a studio of the late 'seventies and early 'eighties before popular opinion was won over and the fashion for old oak on the one hand, and the late eighteenth-century mahogany schools on the other, set in. Trade designers have been, and still are, busy duplicating 'periods'. Conglomerate pieces with Jacobean lines in one portion, eighteenth-century features in another, are much in evidence. In oak and in walnut whole schools have been duplicated, but unfortunately the modern designer has added touches of his own to mar the original symmetry. But on the whole the twentieth century has shown a steady regard for fine design. There is nothing particularly original, but the beauty of the old English furniture designers has been recognized, and this is a great asset towards the foundation of a newer school built on sound design. In regard to upholstery in leather and in other materials, the modern cabinet-maker has become pre-eminent, and his treatment of the chair built on sound lines for comfort is sensible and practical. Factory production on a large scale has eliminated much of the originality associated with periods of greater leisure, but that applies to other arts as well as to that of cabinet-making.—BIBLIOGRAPHY: J. H. Pollen, *Ancient and Modern Furniture and Woodwork*; W. M. Flinders Petrie, *History of Egypt*; P. Macquoid, *History of English Furniture*; A. Hayden, *Chairs on Old Furniture*; and *Chairs on Cottage and Farmhouse Furniture*; Lady Dilke, *French Furniture*; F. Litchfield, *Illustrated History of Furniture*; H. D. Eberlein and Abbot McClure, *The Practical Book of Period Furniture*.

Fur'nivall, Frederick James, English philologist, born at Egham, in Surrey, 1825; educated at University College, London, and Trinity Hall, Cambridge; died in 1910. He was called to the Bar in 1849, but devoted his life chiefly to the study of early and middle English literature; and was mainly instrumental in establishing the Early English Text Society (1864), the Chaucer Society (1868), the New Shakespeare Society (1874), the Browning Society (1881), the Shelley Society (1881), and the Wyclif Society (1882). He was also honorary secretary of the Philological Society, and he edited numerous works, chiefly through the medium of some of these societies, notably the *Six-Text edition of Chaucer's Canterbury Tales* (1868-75).—Cf. F. J. Furnivall, *A Volume of Personal Record*.

Furse, Dame Katherine, British organizer, born 23rd Nov., 1875. A daughter of John Addington Symonds, she married in 1900 the painter C. W. Furse. Through her efforts the Voluntary Aid Detachments, established in 1909, developed their activities at the outbreak of the European War. For some time Mrs. Furse was in France, where she organized the work of the Aid Detachments, but in 1915 she returned to England and became commandant-in-chief of the V.A.D.'s. In 1917 she was appointed Director of the Women's Royal Naval Air Service, and made a G.B.E.

Fur-seal, a name given to several of the Otariidae or 'eared' seals which have a dense covering of fine under-fur. The best known and most valuable is the fur-seal or sea-bear (*Otaria ursina*) of some of the islands connected with Alaska, especially St. Paul's and St. George's, where it breeds. See *Seal*; also *Fur and Fur-trade*.

Fürst (fürst), Julius, Orientalist, born of Jewish parents at Zerkowo, Poland, 1805, died at Leipzig 1873. He devoted himself to philological science, and early showed a marvellously extensive acquaintance with Rabbinical literature. He obtained an appointment as lecturer in the University of Leipzig in 1839, and in 1864 was promoted to the rank of professor. He was the author of numerous works all connected with Oriental philology, chief among which were his *Concordantiæ Librorum Sacrorum Veteris Testamenti Hebraicæ et Chaldaicæ*, and his *Hebrew and Chaldaic Lexicon*. From 1840 to 1851 he edited *Der Orient*, a journal devoted to Jewish language, literature, history, and antiquities.

Fürstenwalde (fürst'en-vâl-dé), a town in Prussia, 30 miles E.S.W. of Berlin, on the right bank of the Spree. It has a brick church of the fourteenth century, and manufactures of woollen and linen cloth, electric lamps, machinery, and glass. Pop. 22,626.

Fürth (fürt), a town in Bavaria, 6 miles

W.N.W. of Nuremberg, at the confluence of the Pegnitz with the Rednitz. It has important and varied manufactures, including mirrors, picture-frames, jewellery, gold-leaf, lead pencils, spectacles, and machinery. Gustavus Adolphus was defeated by Wallenstein in 1632 at Alte Veste, near Fürth. The first steam railway opened in Germany, in 1835, was between Fürth and Nuremberg. Pop. (with suburbs), 68,163.

Furze (A.Sax. *fȳrs*), whin, gorse, the common name of the species of the genus *Ulex*, nat. ord. Leguminosæ. Twelve species have been described, two of which are natives of Britain. The common



Furze, Whin, or Gorse (*Ulex europæus*)

furze (*U. europæus*) is a well-known low shrubby plant, often very abundant in barren, heathy, sandy, and gravelly soils throughout the west of Europe. The stem is generally 2 or 3 feet high, much branched, and most of the leaves are converted into spines. The flowers are solitary and yellow. It often covers exclusively large tracts of country, and makes a splendid appearance when in flower. It is used as fuel, and sometimes the tops of the branches are used (especially the young tops) as fodder for horses and cattle, after having been beaten or bruised to soften the prickles. The dwarf-furze (*U. nanus*) is found in many parts of the British Isles.

Fu-sang, a country referred to in the Chinese work, *Lung Wei Pi Shu*. The trees of Fu-sang are said to be a thousand feet high. Some writers believe that California is referred to, while others favour Mexico. It may be, how-

ever, as recent writers contend, that the mysterious country was Japan. Great trees are referred to in Chinese mythology. One in the Western Paradise reaches to the sky. Stories of these mythical trees may have been mixed up with accounts of Japan when it was very little known to the Chinese.

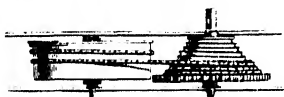
Fusa'rium, a genus of Fungi Imperfecti, including several parasitic species, the most dangerous of which is *F. Lycopersici*, causing the 'sleeping-disease' of the tomato.

Fusa'ro, Lake of (the ancient *Acherusia Palus*), a small Italian lake on the Peninsula of Baia, 11 miles w. of Naples. It is supposed to have been the harbour of ancient Cumæ and is still celebrated for its oysters.

Fuse, a tube filled with combustible matter, used in blasting, or to explode shells, mortars, or bombs. There are many varieties in use, such as the fuse used in mining and quarrying, which usually consists of a tube filled with a slow-burning composition, which gradually burns down to the charge; the *concussion* and *percussion fuses* for hollow projectiles, which explode the charge when an object is struck; the *electric fuse*, which is ignited by the passage of an electric spark through it; and *time* or *mechanical fuses*, used in some forms of torpedo, and with such explosives as dynamite and gun-cotton. See *Fuse, Electric*.

Fuse, Electric, a device for preventing damage in an electric circuit when the current happens to exceed a safe value. The fuse consists of a wire or strip of metal forming part of the circuit, and so designed in material and dimensions that it carries the ordinary current without being damaged, but melts, fuses, or 'blows' whenever the current becomes too large. Fuses are generally made of copper, zinc, tin, or lead, or of alloys of these metals, and are usually mounted in a non-inflammable open case of porcelain or metal. The fuse must be of sufficient length to prevent the formation of an arc when the circuit is broken, at least 1 inch to 1½ inches even for low-pressure currents up to 5 amperes. For currents of more than about 600 amperes, fuses are unsuitable, as they have to be bulky to carry such currents, and the molten metal may become dangerous when the fuse blows. Automatic circuit-breakers, though more expensive, are preferable for large currents, and even for small currents when overloads are frequent.

Fusee', the cone or conical part of a watch or clock, round which is wound the chain or cord. It is a mechanical contrivance for equal-



Barrel and Fusee of a Watch

izing the power of the mainspring; for as the action of a spring varies with its degree of tension, the power derived from the force of a spring requires to be modified according to circumstances before it can become a proper substitute for a uniform power. In order, therefore, to correct this irregular action of the mainspring, the fusee on which the chain or catgut acts is made somewhat conical, so that its radius at every point may be adapted to the strength of the spring.

Füssli (fū'se-li), John Henry (original name *Füssli* or *Fuessli*; fūs'le), a painter, born in 1741 or 1742 at Zürich, died at London, and was buried in St. Paul's Cathedral, 1825. He was educated for the Church, but a political pamphlet written by him and Lavater led to his taking refuge in England in 1765, bent on a literary career. On the advice of Sir Joshua Reynolds he devoted himself to art, went to Italy, and studied there for nearly nine years. He was elected A.R.A. in 1788, R.A. in 1790, lecturer on painting in 1799, and keeper of the Royal Academy in 1804. Among his notable pictures are his contributions to Boydell's *Shakespeare Gallery*, and forty-seven pictures from Milton.

Fusel-oil, a liquid of disagreeable odour obtained during the rectification of alcohol from fermentation of sugars and starches. Alcohol produced from potatoes contains the largest amount of the oil, and the constituents and quantity vary according to the source of alcohol and the method of distillation. Fusel-oil distils mainly at temperatures between 105° and 136° C., and consists chiefly of two alcohols, isomyl alcohol and secondary butyl carbinol, mixed with small quantities of propyl-, butyl-, isobutyl-alcohols, &c. These higher alcohols are deleterious to health, hence their removal from alcohol is necessary if the alcohol is to be used for the preparation of beverages.

Fusible Metal, an alloy, usually of lead, tin, and bismuth, but sometimes containing cadmium also, in such definite proportions as to melt at a given low temperature. The alloy containing lead 32, tin 16, and bismuth 52 melts below the boiling-point of water. In steam-engines, a plug of fusible metal screwed into the crown of the fire-box, so as to melt and allow the steam to blow out the fire if the water gets too low. It is also used for safety-plugs in water-pipes placed in the ceilings of public buildings, or large stores, so that in the event of fire, when the temperature rises, the safety-plugs melt and water is instantly sprayed into the room.

Fusible Porcelain, a silicate of alumina and soda obtained from cryolite and sand, fused and worked as glass.

Fusiliers (Fr. *fusilier*, from *fusil*, gun, musket), formerly soldiers armed with a fusil or light flint-lock musket closely resembling a carabine. The name is given to several regiments in the British army, which differ from other regiments of the line chiefly in the bushy worn by officers and other ranks when in full-dress.

Fusing-point, or **Melting-point**, the temperature at which a solid melts or liquefies; the temperature at which the solid and liquid phases are in equilibrium. Potassium melts at 144° F., tin at 450°, lead at 622°, zinc at 786°, silver at 1764°, gold at 1947°; while cerium and platinum require the temperature of the oxyhydrogen blow-pipe to melt them. Small amounts of impurities always lower the melting-point of a substance.

Fusion, the conversion of a solid body into the liquid state by direct heat, as distinguished from solution, in which the effect is produced by means of a liquid. It is difficult, however, to draw a line between the two, for the main difference is in the temperature, and when a flux is employed all distinction disappears. The term is specially applied to the action of heat on the metals, but it is extended to any solid matter; thus the passage of ice into water at 32° F. is true fusion. There are bodies, like carbon, lime, magnesia, zirconia, and other metallic oxides, which are practically infusible at the temperature attained by the ordinary sources of heat.

Fust, Johann, a goldsmith of Mainz, associated with Gutenberg and Schöffer in connection with the origin of printing. He probably died of the plague in 1466. See *Printing*.

Fustel de Coulanges, Numa Denis, French historian, born in Paris in 1830, died in 1889. He was educated in Paris, studied for some time in Athens, and was professor at Strasbourg from 1860 to 1870. In 1878 he became professor at the Sorbonne, and from 1880 to 1889 he was professor at and director of the École Normale. His works include: *Histoire des institutions politiques de l'ancienne France* (1875-92), *La Gaule Romaine* (1888-91), *Questions Historiques* (1893), &c. His most famous work, however, is his *La Cité antique* (1864), wherein he endeavoured to prove, in a somewhat exaggerated way, that the development of the ancient states of Greece was mainly based on religion.

Fustian (O.Fr. *justaigne*, from *Fustât*, a suburb of Cairo), a cotton or mixed linen and cotton fabric with a pile like that of velvet but shorter. It includes corduroy, moleskin, and velveteen.

Fustic, the wood of the *Chlorophora tinctoria*, a tree of the mulberry order growing in the West Indies. It is a large and handsome tree, and the timber, though, like most other dye-woods, brittle, or at least easily splintered, is hard and strong. It is extensively used as an ingredient

in the dyeing of yellow, and is largely imported for that purpose.—*Young Fustic* is the wood of the *Rhus cotinus* or Venice sumach, a South European shrub with smooth leaves and a remarkable feathery inflorescence. It yields a fine orange colour, which, however, is not durable without a mordant.

Futhork (fy'thork), the name given to the earliest or runic alphabet in use among the Teutonic or Germanic nations of Northern Europe, so called from its first six letters, f, u, th, o, r, k. Three runic alphabets have been recognized. See *Runes*.

Future Estate, comprises all limitations by will of interests in land which, while not to come into existence until a future time or until the occurrence of an event, cannot legally take effect as remainders, even contingent, e.g. where a testator gives a life interest to A and provides that after A's decease the property is to go to all the children of B then in life or *thereafter to be born*. See *Remainders*.

Futurism, a term often loosely applied to the modern movement in art as a whole, but properly describing the doctrines of a group of Italian (mainly Milanese) painters, sculptors, and poets, first published in 1909 in a manifesto signed by F. T. Marinetti, the poet and chief inspirer of the group, and amplified in subsequent manifestos. These doctrines apply to art a general philosophy of life, which has its origin in modern theories relating to matter and energy, and has for its chief points the rejection of all tradition (whence the name Futurism), and the worship of speed and conflict as the typical characteristics of modern civilization. In art, the Futurists aim at representing not what the eye sees, but the sensation of movement and growth itself. One method of doing this is the representation of simultaneous states of mind; so that in painting an object, the artist brings together on one canvas not only what he sees, but what he knows or remembers about it. Another method is the use of 'force-lines'. The Futurists hold that every object is the momentary outcome of continuously acting forces, which are indicated by the object's shape. These forces the artist represents by lines on his canvas; and by arranging them to clash, harmonize, or intermingle, he claims to express various states of mind, such as chaotic excitement, happiness, or interest. Colour the Futurists use arbitrarily to assist in conveying these sensations. The most orthodox of the group is Luigi Russolo; Carlo D. Carra and Giacomo Balla mainly produce descriptive catalogues on canvas, in attractive colour. The work of Umberto Boccioni, both painter and sculptor, is similar, but more attractive in design. Gino Severini, the best known of the Futurists,

was formerly notable for his gay and fanciful colour patterns. Of late, he has turned to Cubism, and has even produced some purely academic work. As a movement, Futurism has produced no lasting effect; but some of its doctrines are shared by the English Vorticists.—BIBLIOGRAPHY: U. Boccioni, *Pittura, Scultura Futurista*; prefaces to *Catalogues of Futurist Exhibitions* in London, 1913 and 1914.

Fyfe, Charles Alan, British historian, born in 1845, died in 1892. He was educated at Balliol College, Oxford, was bursar of University College, then studied law, and was called to the Bar in 1876. In the Franco-Prussian War of 1870 he was correspondent for *The Daily News*, and is said to have sent the first account of the battle of Sedan that appeared in print. During the Commune he was nearly shot as a spy. He wrote a *History of Greece* (1875), but is best known for his *History of Modern Europe* (1880-90).

Fyne (fin), **Loch**, an arm of the sea in Scotland, in the county of Argyll, running north-

wards from the Firth of Clyde for about 40 miles. Its depth varies from 12 to 50 fathoms. It is particularly celebrated for its herrings.

Fyrd (fürd), in Anglo-Saxon England the military array or land force of the whole nation, comprising all males able to bear arms. The array of the fyrd of each shire was left to the ealdorman.

Fyt (fit), John, a Flemish painter and etcher, born at Antwerp in 1609, died there 1661. His subjects were chiefly game, hunting-pieces, dogs, fruit, flowers, and on occasion he painted animals in the pictures of his contemporaries, such as Rubens and Jordaens. His technical skill was great, and his production large. He published three series of etchings of animals.

Fyzabad, or **Faizabad** (fi-za-bäd'), a town, British India, in what was formerly the Kingdom of Oude, on the Gogra, 78 miles E. of Lucknow. It was the scene of one of the outbreaks in the Indian Mutiny. Pop., including cantonments, 54,655.

G

G, the seventh letter in the English alphabet. English *g hard* is a guttural mute, the 'voiced' or soft or sonant sound corresponding to the 'breathed' or hard or surd sound *k* (or *c hard*). This sound of *g* is what the letter always has before *a* (except in *gaol*), *o*, *u*, and when initial also before *e* and *i* in all words of English origin, and when final. The *soft* sound of *g*, or that which it more commonly has before *e*, *i*, and *y*, as in *gem*, *gin*, *gymnastics*, is a palatal sound the same as that of *j*, and did not occur in the oldest English or Anglo-Saxon.

G, in music, (a) the fifth note, and dominant of the normal scale of C, called also *sol*; (b) the lowest note of the grave hexachord; in the Guidonian system *gamma ut*; (c) a name of the treble clef, which is seated on the G or second line of the treble staff, and which formerly had the form of G. Notable compositions in this key are: two of Haydn's symphonies; Beethoven's quartet No. 2, the overture to his '*Ruins of Athens*', and several sonatas; Mozart's symphony; and Mendelssohn's concerto in G minor.

Gaba Tepe, a headland on the west coast of Gallipoli. It was on the narrow beach here that the Australian and New Zealand Army Corps made their famous landing on the morning of 25th April, 1915. See *Gallipoli*.

Gabbro, a name given by von Buch to an Italian rock consisting essentially of diallage and lime felspar altered to saussurite. It is now applied to any coarsely crystalline igneous rock consisting of a pyroxene and a lime-soda or lime-

felspar. The rugged Cuichullin Hills of Skye are largely formed of gabbro.

Gabelle, a name originally given in France to every kind of indirect tax, as on wine and cloth, but at a later period specially applied to the tax upon salt, which, after being frequently imposed as a temporary means of raising money, became under Charles V a permanent impost. Under Henry II nine provinces and three counties purchased perpetual exemption from the tax, but it was only finally suppressed in France by the Constituent Assembly in 1790. About that time, out of 38,000,000 livres raised by farmers-general from this tax, 7,000,000 at most came into the Treasury.—Cf. A. Gasquet, *Précis des institutions politiques de l'ancienne France*.

Gablonz (gä'blonts), a town in the north of Bohemia, Czecho-Slovakia, on the Neisse, famous for its glass industry (imitation pearls and glass ornaments of all kinds). Special instruction is given for this and the bronze manufactures in technical schools.

Gaboon, **The**, or **M'pongo**, an estuary on the west coast of Africa, opening from the Gulf of Guinea immediately north of the equator. Several rivers discharge themselves into it. The Gaboon territory forms part of French Equatorial Africa (French Congo). The chief tribes are the M'pongwa or Gabonese, and the Fans, who carry on an active trade with Europeans in ivory, copal, ebony, and dyewoods. The vast swamps render the climate unhealthy, but inland rise some considerable hills with dense jungle-

like woods, the abode of the gorilla. The chief station is Libreville. There are several English trading-posts along the estuary (Glass Town, Olemi, &c.), and mission stations of several nations.

Gaboriau, Émile, a French novelist, born 1833, died in Paris 1873. After contributing to the smaller Parisian journals short sketches published under the titles *Ruses d'Amour*, *Les Comédiennes Adorées*, &c., he achieved a considerable success by his novel *Dossier No. 113* (1866). He continued to work this vein in a series of clever stories dealing with crime and its detection: *Le Crime d'Orléans*, *L'Affaire Lerouge*, *Les Esclaves de Paris*, *La Vie Infernale*, *La Corde au Cou*, and *L'Argent des Autres*.

Gab'riel ('hero or man of God'), according to Biblical history, the angel who announced to Zacharias the birth of John, and to Mary the birth of the Saviour. In Jewish mythology he is one of the seven archangels. The rabbins say he is the angel of death for the Israelites, and according to the *Talmud* he is a prince of fire, who presides over thunder and the ripening of fruits. In Mohammedan theology he is one of the four angels employed in writing the divine decrees, and the angel of revelation, in which capacity he dictated the *Koran* to Mohammed.

Gad ('a troop'), one of the twelve tribes of Israel, which took its name from Gad, the son of Jacob and Zillah. At the time of the exodus the tribe numbered 45,650 men of twenty years old and upwards; and as being a pastoral tribe they were assigned a rich district in Gilead between Reuben and Manassah. (See *Josh. xiii. 24-28*.)

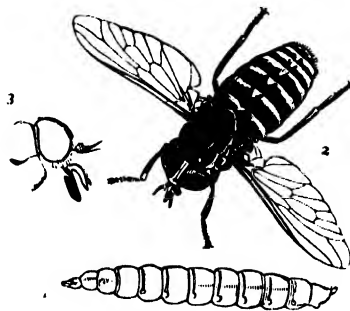
Gadames. See *Ghadames*.

Gad'ara, an ancient city of Palestine, in the Decapolis, about 6 miles S.E. of the Sea of Galilee. It played an important part in the struggles against Antiochus, Alexander Jannæus, and Vespasian, and fell into decay only after the Mohammedan conquest.

Gaddi, (1) Gaddo, born about 1260, died about 1310, a Florentine painter and worker in mosaic. He was a friend of Cimabue and Giotto, and to him mosaics in the cathedral of Florence and in S. Maria Maggiore, Rome, are ascribed. —(2) Taddeo, son of preceding, born 1300, died about 1366, painter, mosaicist, and architect. Instructed by his godfather Giotto, whose assistant he was for twenty-four years, he became one of the most important of his master's successors. He is represented by decorations in S. Croce and S. Maria Novella, Florence. —(3) Agnolo, son of Taddeo, born after 1333, died 1396. His style was based on that of his father and Giotto, and a reputed visit to Venice has led to his being called founder of the Venetian school. —(4) Giovanni, brother of Agnolo, a painter who died young.

Gade (gä'de), Niels Wilhelm, one of the leading Scandinavian composers, born in 1817 at Copenhagen, died in 1890. In 1841 he gained the prize of the Musical Union by his overture entitled *Echoes of Ossian*. He was supported during his studies abroad by a royal stipend, and in 1844 was appointed to succeed Mendelssohn in the direction of the Gewandhaus concerts at Leipzig. In 1850 he was appointed musical director to the King of Denmark, and in 1876 received a life pension. His works, which are Mendelssohnian in character, include seven symphonies, several overtures, sonatas, and quintets; a lyrical drama—*Comala*; a religious cantata—*The Crusaders*, which he conducted at Birmingham in 1876; and an opera—the *Nibelungen*.

Gadfly, two-winged flies of the family Tabanidæ. The females possess piercing mouth-



Gadfly (*Tabanus bovis*)

1, Larva. 2, Female. 3, Head in profile.

parts, and suck the blood of horses and cattle, causing them much annoyance. They also attack human beings. The large gadfly (*Tabanus bovis*), an allied species (*T. autumnalis*), and the cleg (*Hematopota pluvialis*) are especially troublesome. They frequent woods in the neighbourhood of water. The name is sometimes wrongly given to the *warble-flies* (or bot-flies).

Gad'idæ, a family of soft-finned fishes, many of which are of economic importance, such as cod (*Gadus morrhua*), haddock (*G. aglefinus*), whiting (*G. merlangus*), hake (*Merluccius vulgaris*), and ling (*Molva vulgaris*). See *Cod*.

Gad'olinite, a mineral, a silicate of yttrium, generally containing oxides of cerium, lanthanum, glucinum, and sometimes of other bases. It is usually found in dull, amorphous masses disseminated through granite; is black, or very dark green, with a resinous lustre. It was named after the mineralogist Gadolin, professor at Åbo, 1785-1822.

Gadshill, an eminence in the county of Kent, on the Gravesend road, 3½ miles north-west by

west of Rochester. In olden times there were woods on either side of the ascent, and these used to be the lurking-place of highwaymen. Shakespeare, in *Henry IV*, makes it the scene of the robberies of Prince Hal and Falstaff. Charles Dickens spent the last years of his life (from 1860 to 1870) at Gadshill House close by.

Gadwall', the common name of *Chaulelasmus streperus*, a species of duck not so large as the mallard, with long pointed wings and a vigorous and rapid flight. North America as far down as South Carolina is its favourite habitat; but it also ranges through the northern half of the Old World. It is not often found in Britain and Ireland.

Gaekwar, or **Gaikwar** (gik-wär). See *Baroda*.

Gaelic (gäl-ik), the name of a Celtic language spoken in the Highlands of Scotland, Ireland, and the Isle of Man. Gadhel or Gael is the only name by which those who speak the Gaelic language are known to themselves. By way of distinction the Highlanders of Scotland call themselves Gael Albinnich (Gael of Albin), and in their Celtic language the people of Ireland call themselves Gael Erinnich (Gael of Erin). See *Celtic Civilizations*; *Celtic Literature*.

Gaëta (gä-ä'tä; anciently **Caleta**), a strongly fortified seaport town of South Italy, province of Caserta, on the Gulf of Gaëta, the seat of a bishop, 45 miles north-west of Naples. It is a place of great antiquity, was a favourite resort of the wealthy families of Rome, and since the fifth century has had a prominent place in the history of Italy, and especially in that of the Kingdom of Naples. Francis II, the last Bourbon King of Naples, was besieged at Gaëta by Garibaldi in 1860. Pop. 5670.

Gætulla, the ancient name of an extensive region of Africa, on the southern slope of Mount Atlas. It corresponds to the modern Biledulgerid, the southern part of Morocco, and the northern part of the Sahara. It was inhabited by warlike tribes, who are supposed to have been the ancestors of the modern Tuaregs of the Sahara oases.

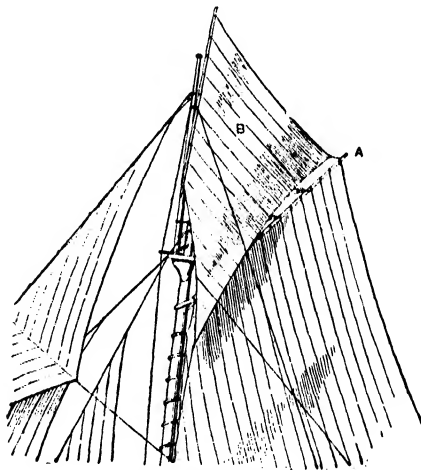
Gaff, a spar used in ships to extend the upper edge of fore-and-aft sails which are not set on stays. The fore-end of the gaff, where it embraces the mast, is termed the *jaw*, the outer end the *peak*. The jaw forms a semicircle, and is secured in its position by a jaw-rope passing round the mast.

Gaillac (gä-yäk), a town of Southern France, department of Tarn, on the right bank of the Tarn. It exports a good red table-wine, the district abounding in vineyards. Pop. 7740.

Gaillarde (gä-yärd; It. *Gagliarda*), a lively Italian dance, in triple time; also called, from its alleged origin, *Romanesque*. It is mentioned

by Shakespeare, *Twelfth Night*, i, 3, 129, and *Henry V*, i, 2, 252.

Gainsborough, Thomas, English painter, born at Sudbury, in Suffolk, 1727, died in London 1788. He was trained under the engraver Gravelot and the painter Hayman, and worked for a short time in London. He then returned to Suffolk, and married, in 1746, Margaret Burr, who brought with her a competence. In 1760 he went to Bath, and at once became a popular and successful portrait painter. In 1774 he moved to London, and shared with Reynolds and Romney the patronage of the fashionable world. An original member of the Royal Academy, he contributed regularly to its exhibitions until



Gaff, A. Gaff-topsail, B

1783, when a dispute over the hanging of a picture caused his refusal to exhibit further. His portraits and landscape (in which latter his naturalism makes him a pioneer) are marked by a subtle handling of tone, and a delicate feeling for colour, which put him in the front rank of English artists.—BIBLIOGRAPHY: Sir W. Armstrong, *Gainsborough and his place in English Art*; W. T. Whitley, *Thomas Gainsborough*.

Gainsborough, a market town, England, county of Lincoln, 15 miles north-west of the town of Lincoln, on the Trent, which is navigable by vessels of from 150 to 200 tons, and is connected with the main canal system. Among the chief buildings are the parish church, the town hall, and the old hall or manor-house, containing the rooms of the literary and scientific institute—a quaint building. There are oil-mills, breweries, rope-walks, foundries, and malt-houses. Water is obtained from artesian wells. Gainsborough gives its name to a parliamentary

division of the county (Parts of Lindsey). Pop. (of town), 19,694.

Gairdner, James, historian, was born in 1828 at Edinburgh, where he received his education, died in 1912. In 1846 he entered the Public Record Office, and in 1859 became an Assistant Keeper. He edited, for the Master of the Rolls, *Memorials of Henry VII* (1858), and *Letters and Papers of the Reigns of Richard III and Henry VII* (1861-3), and on Professor Brewer's death was appointed to succeed him as editor of the *Calendar of State Papers of Henry VIII* (London, 1862-1905). He also edited the *Paston Letters* (1872-5, with supplementary volume, 1900), *Historical Collections of a Citizen of London, Three Fifteenth Century Chronicles*; and was the author of the *Houses of Lancaster and York* (Epochs of Modern History Series), *The Life and Reign of Richard III, England* (Early Chronicles of Europe Series), *Studies in English History* (with Spedding), *Henry VII, The English Church in the Sixteenth Century to the Death of Mary* (1902), and *Lollardy and the Reformation in England* (1908-11); besides writing numerous articles in the *Dictionary of National Biography*. He was an LL.D. of Edinburgh, and was made a C.B. in 1900.

Gairdner, Sir William Tennant, sanitary reformer and physician, was born in Edinburgh in 1824, died in 1907. Like his younger brother James (q.v.), he was educated in his native town. In 1845 he took his M.D. degree at the university, and won a gold medal, and from 1846 to 1862 was connected with the Edinburgh Royal Infirmary as resident medical officer and pathologist. In the latter year he was appointed to the chair of medicine in Glasgow University, which he held until his resignation in 1900. The publication in 1862 of his book *Public Health in relation to Air and Water* led to his appointment as medical officer to the city of Glasgow, an entirely new post, during his tenure of which (1863-72) epidemics were combated and the sanitary arrangements of the city completely revolutionized. He was made a K.C.B. in 1898, and was honorary physician-in-ordinary to the king in Scotland. He is the author of *Clinical Medicine* (1862), *Lectures to Practitioners* (with Dr. J. Coats, 1888), *The Physician as Naturalist* (1889), and *The Three Things that Abide* (1903).

Gaius, a Roman lawyer of the time of Adrian and Antoninus Pius, of whose life very little is known. Of his numerous works, his *Institutes* are particularly important; first, as having been for centuries, down to the time of Justinian, one of the most common manuals of law; secondly, as having been the foundation of the official compendium of the law which occupies an important place in the reform of the judicial system by Justinian; and thirdly, as the only tolerably full,

systematic, and well-arranged source of the old Roman law. The bulk of the work in MS. was discovered in 1816 by Niebuhr. An English translation by E. Poste appeared in 1885.—Cf. J. Ortolan, *Législation romaine*.

Galactose ($C_6H_{12}O_6$), a sugar formed together with glucose when milk-sugar or lactose ($C_{12}H_{22}O_{11}$) is boiled with dilute acids.

Galago (ga-lā'go), the native name of a genus of lemurs found in Africa. The species, which are nocturnal in their habits, have long hind-legs, great eyes, and large membranous ears. The great galago (*G. crassicaudatus*) is as large as a rabbit. They live in trees, and are sought after as food in Africa.

Galahad, Sir, the son of Lancelot and Elaine in the Arthurian romances. He was the noblest of the Knights of the Round Table, a model of purity and chivalry. Having set out on the quest of the Holy Grail, Sir Galahad redressed all wrongs and grievances which he came across on his journey. He is the hero of Walter Map's *Quest of the Holy Grail*.

Galan'ga, or **Galangal Root**, a dried rhizome brought from China and used in medicine, being an aromatic stimulant of the nature of ginger. It is mostly produced by *Alpinia officinarum*, a flag-like plant about 4 feet high, with narrow lanceolate leaves and simple racemes of white flowers. The greater galangal is the rhizome of *A. Galanga*.

Galap'agos (the Spanish for 'tortoises'), a group of thirteen islands of volcanic origin in the North Pacific Ocean, about 600 miles west of the coast of Ecuador, to which they belong; area, 2870 sq. miles. The most important are Albemarle, 60 miles long by 15 miles broad, and rising 4700 feet above the sea; Indefatigable, Chatham, Charles, James, and Narborough. Of these some are used by the Republic of Ecuador as penal settlements. Many of the fauna and flora of the islands are peculiar to them, the most remarkable being a large lizard and the elephant tortoise.

Galashiels (gal-a-shēlz'), a town in Scotland, one of the Hawick district of parliamentary burghs, in the county of Selkirk, on both sides of the Gala, about a mile above its confluence with the Tweed, 3½ miles from Melrose, and 27 miles S.S.E. of Edinburgh. It is noted for its manufactures of tweeds, plaids, shawls, and woollen yarns. The town, which is of rather irregular construction, lies in a narrow valley, and is about 2 miles long. Pop. 12,946.

Galate'a, in classic mythology, the daughter of Nereus and Doris, who rejected the suit of the Cyclops Polyphemus and gave herself to the Sicilian shepherd Acis. The monster, having surprised them, crushed Acis beneath a rock. (See Austin Dobson's *Tale of Polypheme*.) *Galatea* is also the name of a statue said to have been

endowed with life by Venus at the prayer of the sculptor Pygmalion. This story, which is derived from Ovid, *Metamorphoses*, x, 243, is the subject of a well-known comedy by Sir W. S. Gilbert, produced in 1871.

Galatia, the ancient name of an extensive region in Asia Minor, so called from its Gallic inhabitants, who in the first place formed part of the invading hordes of Gauls under Brennus in the third century B.C. These were compelled by Attalus, King of Pergamos, to settle within well-defined limits between Paphlagonia, Pontus, Cappadocia, Lycaonia, Phrygia, and Bithynia. With the Gauls were intermingled a considerable proportion of Greeks; hence the inhabitants were often called Gallogræci, as well as Galatians.

Galatians, *Epistle to the*, one of the most important epistles of St. Paul, written probably about A.D. 56, soon after his second visit to Galatia, recorded in *Acts*, xviii, 23. It was directed against the spread of Judaistic practices in the Galatian churches, and especially against the practice of circumcision. It has been the subject of numerous commentaries, by Luther, Winer, Meyer, Ellicott, Alford, Drummond, and others.—Cf. article in *Encyclopædia Biblica*.

Galatz, or **Galacz**, a town and port in Roumania, in Moldavia, on the left bank of the Danube, between the confluence of the Sereth and Pruth. It consists of an old and a new town, the latter on a hill dominating the river and commanding a fine view of the Balkans. The harbour, accessible to vessels drawing 15 feet, is well frequented, and an emporium of trade between Austria, Russia, and Constantinople. The trade was formerly entirely in the hands of the Greeks, but now many British and other foreign houses have established themselves. The chief exports are grain (principally maize), wine, plunks and deals, and tallow. The imports are chiefly British manufactures, sugar, tin plates, iron and steel, coal, oil, fruits, tobacco, fish, glass-ware, leather, coarse cloth. When made a free port in 1834, it had only 8000 inhabitants, but in 1917 the population was 72,512. It ceased to be a free port in 1883.

Galaxy (*Via Lactea*, or Milky Way), in astronomy, that long luminous track which is seen at night stretching across the heavens from horizon to horizon, and which, when fully traced, is found to encompass the heavenly sphere like a girdle. This luminous appearance is occasioned by a multitude of stars so distant and blended as to be separately distinguishable only in telescopes. At one part of its course it divides into two great branches, which remain apart for a distance of 150° and then reunite; there are also many other smaller branches that it gives off. At one point it spreads out very widely, exhibiting a fan-like expanse of interlacing branches nearly

20° broad; this terminates abruptly and leaves here a kind of gap. At several points are seen dark spots in the midst of some of the brightest portions; one of the most easily distinguished of these dark spots has long been known as the 'coal-sack'. The appearance of the Milky Way shows that our sun is nearly in its medial plane, and probably not far proportionately from its centre. Some astronomers believe that the spiral nebulae, of which the Great Nebula in Andromeda is to our view the largest, are external galaxies, and that our galaxy seen from one of them would present merely the appearance of a spiral nebula.

Galba, Servius Sulpicius, Roman emperor, successor of Nero, born 3 B.C. He was made prætor (A.D. 20), and afterwards Governor of Aquitania, and in A.D. 33 was raised to the consulship through the influence of Livia Drusilla, the wife of Augustus. Caligula appointed him general in Germany, and Claudius sent him in A.D. 45 as proconsul to Africa, his services there obtaining him the honours of a triumph. He then lived in retirement till the middle of Nero's reign, when the emperor appointed him Governor of Hispania Tarraconensis, but soon after ordered him to be secretly assassinated. Galba revolted; the death of Nero followed (A.D. 68), and he himself was chosen emperor by the prætorian cohorts in Rome. He went directly to Rome, but soon made himself unpopular by cruelty and avarice, and he was slain in the forum in A.D. 69 at the age of seventy-two.

Gal'banum, or **Galban** (Gr. *chalbanē*, Heb. *khālab*, to be fat), a fetid gum resin procured from at least two species of umbelliferous plants, which are probably *Ferula galbaniflua* and *F. rubricaulis*. It consists of the 'tears' of gum resin which exude spontaneously from the stem, especially in its lower part and about the bases of the leaves. It is brought from the Levant, Persia, and India, and is administered internally as a stimulating expectorant. It is also used in the arts, as in the manufacture of varnish. It is supposed to be yielded by other umbellifers, among which are named *Ferulago galbanifera*, *Opodia galbanifera*, and *Bubon Galbanum*.

Galchas, a number of tribes dwelling on the plateaus and in the valleys of Kohistan, in Ferghana, and on the basins of the Amu Darya and Zarafshan. They are of Aryan stock linguistically, and physically seem to belong to the Celtic-European or Alpine race. They are brachycephalic, have blue, brown, or grey eyes, aquiline noses, black, chestnut, or red hair, and white or brown complexions. They are mostly Sunni-Mohammedans by religion.—**BIBLIOGRAPHY**: Ripley, *Races of Europe*; Charles Eugene D'Ujfalvy de Mezoe-Koevsd, article in *Revue d'Anthropologie* (1879).

Galdos, Benito Pérez, Spanish novelist, born on one of the Canary Islands in 1845, died in 1920. He studied law at Madrid, but soon turned to literature, and at first devoted himself to the patriotic historical story. He thus produced in 1871 his first novel, *La Fontana de Oro*, which was followed by a series of novels under the general title of *Episodios nacionales* (20 vols., 1872-80). Among his other works are: *Doña Perfecta*, *Gloria*, *Tormento*, *Tristana*, &c. He also wrote dramas: *La Realidad*, *Los Condenados*, *Electra*, &c. The production of *Electra* was prohibited on account of its anticlerical tendencies.

Gale, a plant of the genus *Myrica*, nat. ord. Myricaceæ. Sweet gale or bog-myrtle (*M. Gale*) is a shrub from 1 to 3 feet high, which exhales a rather pleasant aromatic odour, and grows on wet heaths abundantly. In America the name is applied to an allied plant, *Comptonia asplenifolia*. See *Candleberry*.

Gale'mys. See *Musk-rat*.

Galen, properly *Claudius Galenus*, a Greek physician, born A.D. 130 at Pergamus, in Asia Minor. He is called Gallien by mediæval writers. His father, Nicon, an architect and mathematician, gave him a careful education, and he studied under physicians in Smyrna, Corinth, and Alexandria, afterwards visiting Cilicia, Phœnicia, and Palestine. He returned in 158 to Pergamus, where he received a public appointment, but five years later went to Rome, and there acquired great celebrity by his cures. Driven thence by envy, he again travelled for some time and resumed his labours in his native town, but was soon after invited to Aquileia by the Emperors Marcus Aurelius and Lucius Verus (A.D. 169). He followed Marcus Aurelius to Rome, and appears to have remained there for some years before finally retiring to Pergamus. The closing part of his life, however, is obscure. One Arabic writer says that he died in Sicily, and Suidas states that he died at the age of seventy, and accordingly in the year A.D. 200 or 201; but it is not improbable that he lived longer. The writings attributed to Galen include eighty-three treatises acknowledged to be genuine, forty-five manifestly spurious; nineteen of doubtful genuineness, and fifteen commentaries on different works of Hippocrates, besides a large number of short pieces and fragments, probably in great part spurious. The most valuable of his works were those dealing with anatomy and physiology, and he was the first to establish the consultation of the pulse in diagnosis and prognosis. Till the middle of the sixteenth century his authority in medicine was supreme.—Cf. N. F. J. Eloy, *Dictionnaire historique de la médecine*, s.v. *Galen*.

Gale'na (Pb S), mineral sulphide of lead,

found both in masses and crystallized in cubes, often combined with octahedra; its colour is bluish-grey, like lead, but brighter; lustre metallic; soft, but brittle, breaking along its cleavage-planes parallel to the faces of the cube; specific gravity, 7·5; effervesces with nitric and hydrochloric acids. When pure, it contains about 80·6 per cent of lead and 13·4 of sulphur, but some silver is generally present, and the commercial value of the ore depends greatly on the amount. Antimony, zinc, iron, and bismuth may be present. In the British Isles, galena often occurs in the Carboniferous Limestone, as in Derbyshire. Among the most famous deposits are those of the silver-producing districts of Leadville, Colorado; Utah; Idaho; Burma; and the Broken Hill districts of New South Wales and Rhodesia.

Gale'na, a town of the United States, in Illinois, near the borders of Wisconsin, in the great lead region, situated on both sides of the Fèvre River, 6 miles above its junction with the Mississippi. Pop. 4835.—Another *Galena*, also named from lead-mines, is in the south-east of Kansas. Pop. 6100.

Ga'lenists, the name of the body of controversialists who, appealing to the authority of Galen, opposed the introduction of chemical and alchemical methods of treatment into medicine. They adhered to the ancient formulas, which prescribed preparations of herbs and roots by infusion or decoction, while the chemists professed to extract essences and quintessences by calcination, digestion, or fermentation. Neither body possessed a monopoly of the truth, and modern medicine combines the better elements in each method.

Galeop'sis, the generic name of the hemp-nettles, a genus of plants, of the nat. ord. Labiatae, characterized by the equally five-toothed calyx. They are herbaceous plants with square stems, usually clothed with sharp bristly hairs, nettle-like leaves on long stalks, and red, white, or yellow labiate flowers. There are about twelve species, three of which are natives of Britain. The handsomest of these (*G. versicolor*) is abundant in Scotland, especially in the Highlands; it has showy yellow flowers, with a broad purple spot on the lower lip.

Galerie des Glaces, a famous gallery in the Palace of Versailles. It is one of the most magnificent rooms in the world, is 240 feet long, 40 feet wide, and 42 feet high, is profusely ornamented, and is lighted by seventeen large windows. It derives its name from the huge mirrors which are on one side of the room, opposite and corresponding to the number of windows on the other. The ceiling was painted by Charles Lebrun (1619-1690). Until the Revolution balls and fêtes were given in the Galerie des Glaces,

and during the Second Empire a ball was given here in Aug., 1855, in honour of Queen Victoria. On 18th Jan., 1871, King William I of Prussia was proclaimed German Emperor in the Galerie des Glaces, and on 28th June, 1919, the German delegates signed the Peace Treaty with the Allies in this apartment.

Galerius, a Roman emperor. See *Maximianus II*.

Galesburg, a city of the United States, in Knox county, Illinois. It has railroad workshops, iron-foundries, and manufactures of agricultural implements. Knox College and Lombard University are situated here. Pop. 22,089.

Galeus, the genus including topes, small sharks of the family Carchariidae. The common tope (*Galeus canis*) is abundant in British seas. It is 4 to 6 feet long, and feeds on small fishes and various invertebrates on the sea-bottom.

Galicia (Pol. *Halicz*), a former province of the Austrian Empire, since 1919 absorbed in Poland and Ukraine (q.v.). It is bounded by Podolia, Volhynia, Bessarabia, and the Carpathians; has an area of 30,321 sq. miles, and a pop. of 8,211,770. The great physical features of the country are, in a manner, determined by the Carpathians, which form a long and irregular curve on the south, and send out branches into Galicia. Farther to the north the hills subside rapidly, and finally merge into vast plains. It has several considerable rivers, those in the west being affluents of the Vistula, those in the east, of the Danube and Dniester. The climate is severe, particularly in the south, where more than one of the Carpathian summits rise beyond the snow-line. The summers are very warm but comparatively short. The soil in general is fertile, and yields abundant crops of cereals, hemp, flax, and tobacco. The domestic animals include great numbers of horned cattle, and a fine hardy breed of horses. Sheep are in general neglected; but goats, swine, and poultry abound, and bee-keeping is practised on a large scale. Bears and wolves are still found in the forests; and all the lesser kinds of game are in abundance. The minerals include marble, copper, calamine, coal, iron, petroleum, and rock-salt. Only the last two are of much importance. Rock-salt is particularly abundant. The most important mines have their central locality at Wielezka. Manufactures have not made much progress. The spinning and weaving of flax and hemp prevail to a considerable extent on the confines of Silesia. Distilleries exist in every quarter. The Roman Catholics and the Greek Catholics are the chief religious bodies. The chief educational establishments are the University of Lemberg (Lwów) and that of Cracow. The principal towns are Lemberg, the capital, and Cracow. After being the field of continuous strife between

Russians, Poles, and Hungarians, Galicia continued a Polish dependency from 1382 until the first partition of Poland, in 1772, when it was acquired by Austria. Until 1918 Galicia was one of the Cis-Leithan provinces of the Austrian Empire, and was represented in the *Reichsrath* by 63 Deputies, while the affairs peculiar to itself were deliberated and determined upon by its own *Landtag* or Diet. During the European War Galicia was the scene of heavy fighting and of extended operations by the Russians. See *Galician Campaign; Poland; Ukraine; European War*.

Galicia, one of the old provinces of Spain, situated in the north-west, and bounded north and west by the Atlantic, south by Portugal, and east by the old provinces of Asturias and Leon. It is now divided into the provinces of Coruña, Lugo, Orense, and Pontevedra; area, 11,256 sq. miles. Its broken coast, which has a length of about 240 miles, lies open to the Atlantic, and there are several fine natural harbours, of which Ferrol is one of the finest naval ports in Europe. The surface is mountainous, and the proportion of good arable land limited; but fruit, particularly apples and pears, nuts, walnuts, and chestnuts, is abundant; and the culture of the vine is common in all the lower districts. The higher mountain slopes are generally covered with fine forests, which feed large herds of swine, and afford haunts to boars and wolves. Both manufactures and trade are insignificant. The chief town is Santiago de Compostella. The natives (Gallegos) speak an uncouth patois, which other Spaniards scarcely understand. The peasantry are very poor, and many leave for service in other parts of Spain. Pop. 2,108,914.—Cf. W. Wood, *A Corner of Spain*.

Galician Campaign. One of the first acts of the Russian Empire after the declaration of war in 1914 was to invade the Austrian province of Galicia. In the beginning this invasion was successful, Przemysl being invested by 24th Sept., and a rapid advance made towards Cracow and the Carpathians. By the 28th Krosno had been captured, and the Dukla Pass occupied. The Austrians now took the offensive, drove the Russians back to the River San, and forced them to raise the siege of Przemysl (11th Oct.). In that and the following month the Russians, in their new position, not only withstood the Austrian attacks, but forced their army to retreat on Cracow, and by 12th Nov. were again investing Przemysl, and thrusting the Austrians from the line of the Dunajec. The Austrians now began an offensive from Cracow but were severely defeated, and, by the end of the month, all the Carpathian passes were again in Russian hands. In December a further Russian attempt was

made on Cracow, but owing to a vigorous Austro-German counter-stroke from the direction of Hungary this was unsuccessful. At Przemyśl, meanwhile, the Austrians were making violent but ineffectual sorties from the town, and the year ended with an Austrian retreat and the reoccupation of the Carpathian passes by the Russians.

In Jan., 1915, the Russian army was aligned along the Carpathians as far as Bukovina, and was successfully repelling Austrian attacks; on 22nd March the Russians captured Przemyśl, but lost it, together with most of their other gains, in June, and finally, after some intermittent successes, took up a new position (Grodok) covering Lemberg. On the last day of the year the Russian general, Ivanoff, started another offensive on a front of 250 miles, from the Pripiet marshes in Poland through Galicia to the Roumanian frontier, in which both sides claimed successes. By the end of March, 1916, this offensive had died down—partly owing to the thaw—and in April General Brusiloff succeeded Ivanoff. In June a fresh offensive was again started on the same front, and by August the Russians claimed to have taken nearly 400,000 prisoners and some 400 guns, besides capturing the fortresses of Lutsk, Buczacz, Czernowitz, and others. In August Roumania entered the war, and by September her armies were in touch with the Russians. The year closed with heavy fighting in favour of the Austro-Germans.

During the first half of 1917 the Germans were particularly active in Galicia, and the Russians were gradually forced back, Kalusz, 30 miles s.w. of the River Dniester, being evacuated in July. This was the beginning of the end. The Russian troops became insubordinate, with the natural result that the retreat degenerated into a rout, and by the end of the month the remaining Russian troops were once more beyond their own frontier and Galicia was clear. See *European War*.

Gal'ilee, in the time of Jesus Christ, the most northern province of Palestine, bounded on the east by the River Jordan, on the south by Samaria, on the west by the Mediterranean Sea and Phœnicia, and on the north by Syria and the Mountains of Lebanon. It was in some sense the cradle of Christianity, Nazareth, Cana, Capernaum, Nain, and other places being intimately associated with the life of Christ. The inhabitants of this province, who were mostly farmers or fishermen, on account of their ignorance, were despised by the Jews, who, by way of contempt, called Christians, at first, *Galileans*. At present Galilee is one of the ten districts of Palestine.

Galilee, a portico or chapel annexed to a church, used for various purposes. In its public

penitents were stationed, dead bodies deposited previously to their interment, and religious processions formed; and it was only in the galilee that in certain religious houses the female relatives of the monks were allowed to converse with them, or even to attend divine service. The only English buildings to which the term galilee is applied are attached to the cathedrals of Durham, Ely, Lincoln, Salisbury, and Wells.

Galilee, Sea of, also called Sea of Chinnereth or Chinneroth, and the Lake of Gennesaret or Tiberias, a pear-shaped freshwater lake in Central Palestine, $12\frac{1}{2}$ miles long by $7\frac{1}{2}$ miles broad. It was apparently formed by subsidence attended with volcanic disturbance; and is 682 feet below the level of the Mediterranean. On the east the coasts are nearly 2000 feet high, deeply furrowed by ravines but flat along the summit. The whole basin is bleak and monotonous, and has a scathed volcanic look, the cliffs and rocks along the shore being of hard porous basalt. At the time of Christ there were on its shores nine flourishing cities, of which seven are now uninhabited ruins, while Magdala and Tiberias are both in a poverty-stricken condition. The lake still abounds in fish, but the fishery is neglected.—Cf. G. A. Smith, *Historical Geography of the Holy Land*.

Galilei (gāl-i-lā'ē), Galileo, a most distinguished Italian physicist, born 18th Feb., 1564, at Pisa, died 8th Jan., 1642. His father, Vincenzo Galilei, a nobleman of Florence, procured him an excellent education in literature and the arts, and in 1581 he entered the University of Pisa. At nineteen the swinging of a lamp in Pisa Cathedral led him to investigate the laws of the oscillation of the pendulum, which he subsequently applied to the measurement of time; and in 1586 the works of Archimedes suggested his invention of the hydrostatic balance. He now devoted his attention exclusively to mathematics and natural science, and in 1589 was made professor of mathematics in the University of Pisa. In 1592 he was appointed professor of mathematics in Padua, where he continued eighteen years, and his lectures acquired European fame. Here he made the important discovery that the spaces through which a body falls, in equal times, increase as the numbers 1, 3, 5, 7. If he did not invent he improved the thermometer, and made some interesting observations on the magnet. To the telescope, which in Holland remained not only imperfect but useless, he gave a new importance. He noted the irregularity of the moon's surface, and taught his scholars to measure the height of its mountains by their shadow. A particular nebula he resolved into individual stars, and conjectured that the Milky Way might be resolved in the same manner. His most remarkable discovery was that of Jupiter's satellites (1610), and he

observed, though imperfectly, the ring of Saturn. He also detected the sun's spots, and inferred, from their regular advance from east to west, the rotation of the sun, and the inclination of its axis to the plane of the ecliptic. In 1610 Cosmo II, Grand-Duke of Tuscany, appointed him grand-ducal mathematician and philosopher, and with increased leisure he lived sometimes in Florence, and sometimes at the country seat of his friend Salviata, where he gained a decisive victory for the Copernican system by the discovery of the varying phases of Mercury, Venus, and Mars. In 1611 he visited Rome for the first time, where he was honourably received; but on his return to Florence he became more and more involved in controversy, which gradually took a theological turn. The monks preached against him, and in 1616 he found himself again obliged to proceed to Rome, where he is said to have pledged himself to abstain from promulgating his astronomical views. In 1623 Galileo replied to an attack upon him in his *Saggiatore*, a masterpiece of eloquence, which drew upon him the fury of the Jesuits. In 1632, with the permission of the Pope, he published a dialogue expounding the Copernican system as against the Ptolemaic. A congregation of cardinals, monks, and mathematicians, all sworn enemies of Galileo, examined his work, condemned it as highly dangerous, and summoned him before the tribunal of the Inquisition. The veteran philosopher was compelled to go to Rome early in 1633, and was condemned to renounce upon his knees the truths he had maintained. At the moment when he arose, he is said (but this is doubtful) to have exclaimed, in an undertone, stamping his foot, "*E pur si muove!*" (and yet it moves!). Upon this he was sentenced to the dungeons of the Inquisition for an indefinite time, and every week, for three years, was to repeat the seven penitential psalms of David. After a few days' detention his sentence of imprisonment was commuted to banishment to the villa of the Grand-Duke of Tuscany at Rome, and then to the archiepiscopal palace at Sienna. He was afterwards allowed to return to his residence at Arcetri, near Florence, where he employed his last years principally in the study of mechanics and projectiles. The results are found in two important works on the laws of motion, the foundation of the present system of physics and astronomy. At the same time he tried to make use of Jupiter's satellites for the calculation of longitudes; and though he brought nothing to perfection in this branch, he was the first who reflected systematically on such a method of fixing geographical longitudes. He was at this time afflicted with a disease in his eyes, one of which was wholly blind and the other almost useless, when, in 1637, he discovered

the libration of the moon. Domestic troubles and disease embittered the last years of Galileo's life. His remains were ultimately deposited in the church of Sta Croce, at Florence. A complete edition of Galileo's works appeared in 20 volumes at Florence, 1890-1909. — **BIBLIOGRAPHY:** P. Chasles, *Galileo Galilei*; Sir David Brewster, *Martyrs to Science, or the Lives of Galileo, Tycho Brahe, and Kepler*; J. J. Fahie, *Galileo: his Life and Work*; W. W. Bryant, *Galileo*.

Gal'ingale, a name applied to a kind of sedge, the *Cyperus longus*, or to its tubers, which contain a bitter principle, and have tonic and stomachic properties. They also yield a perfume. See *Cyperus*.

Gal'ipot, or French Turpentine, the long, soft, staccatic pieces of resin which form down the sides of the *Pinus maritima* by evaporation of part of the volatile oil.

Gall, Franz Joseph, the founder of phrenology, born in 1758 in Tiefenbrunn, in Baden, died in 1828. He studied medicine, and practised at Vienna as a physician, where he made himself favourably known by his *Philosophisch-medizinische Untersuchungen* (1791). After a series of comparisons of the skulls both of men and animals, he advanced the theory that it was possible to locate definitely twenty mental faculties. For some time he confined himself to lecturing on the subject, first in Vienna, and afterwards in his travels through Germany. He then accompanied Dr. Spurzheim, in 1807, to Paris, where he published with his friend, in 1810, the *Anatomie et physiologie du système nerveux en général, et du cerveau en particulier*; and in 1812 his own *Des dispositions innées de l'âme et de l'esprit, ou du matérialisme*. Spurzheim also published, in London, a work upon his own and Gall's discoveries, which met with severe criticism but extended their views, and at least gave an impulse to the accurate anatomical study of the brain. See *Phrenology*.

Gall, St. (Ger. *St. Gallen*), a north-eastern frontier canton in Switzerland, abutting on Lake Constance; partly bounded by the Rhine, and enclosing the canton of Appenzell. Its area is 779 sq. miles. In the south it is one of the loftiest Alpine districts of Switzerland, and in other quarters is more or less mountainous. It belongs wholly to the basin of the Rhine, in the valley of which the climate is comparatively mild, while in the mountainous districts it is very rigorous. Wood and good pasture are found on the mountains; on the lower slopes and valleys, vines and orchard fruits, and corn, maize, hemp, and flax are grown. The manufactures are chiefly cotton and linen goods, particularly fine muslins. The constitution is one of the most democratic in Switzerland. The canton sends fifteen representatives to the National

Council. German is the language spoken. Pop. 304,000.—*St. Gall*, the capital and the see of a bishop, is situated on the Steinach, 2165 feet above sea-level. It contains an old cathedral, now completely modernized, and an old abbey partly converted into public offices, but containing also the bishop's residence and episcopal library with valuable manuscripts. The manufactures consist chiefly of cotton goods, more especially embroidered muslins and prints; and the town is the entrepôt both for its own canton and those of Appenzell and Thurgau. It is of ancient origin, having grown up around the abbey of St. Gall, founded by an Irish monk of that name about the beginning of the seventh century. This abbey for several centuries held one of the highest places in the Benedictine order. Pop. (1919), 60,500.

Gallait (gâl-lâ), Louis, Belgian historical painter, born 1810, died 1887. He studied at his native town Tournai, Antwerp, and Paris, where he acquired a name by his portraits as well as his genre and historical paintings. Among his earlier pictures of note were: *Christ restoring Sight to a Blind Man*; followed by the *Temptation of St. Anthony*; *The Dead Bodies of Counts Egmont and Horn*; *The Prisoner's Family*; *The Last Moments of Count Egmont*; *Alva signing Death-warrants*; and lastly (1882), *The Plague at Tournai*. His work is popular and melodramatic, and of no great artistic interest.

Galland (gâl-ân), Antoine, a French Oriental scholar, born in Picardy in 1646, died in 1715. He is principally known for his translation of the *Arabian Nights' Entertainments* (in 12 vols., 1704-17), the first into any European language. Among his other writings are a *Treatise on Medals and Coins*; *Tableau de l'empire Ottoman*; *De l'origine du café*; *Paroles remarquables, bons mots et maximes des orientaux*; and the *Contes et fables Indiennes de Bidpai et de Lokman*. In 1709 he was appointed professor of Arabic at the Collège Royal at Paris, and died while engaged in translating the *Koran*.

Gallas, or **Oroma** (*Ilm' orma*, Sons of the Brave), a numerous and powerful Ethiopian race, chiefly inhabiting a territory in East Africa, lying south of Abyssinia proper. They are members of the Hamitic race, and are closely akin to the earliest inhabitants of Egypt. Their colour varies from a deep black to a brownish yellow; stature tall; bodies spare, wiry, and muscular; nose often straight, or even arched; lips moderate; hair often hanging over the neck in long twisted plaits. They are handsome and brave, but ferocious and cruel, cunning and faithless. They leave the plains to their horses, sheep, and cows, while they themselves cultivate the mountains. There are, however, wandering Gallas mainly occupied in hunting and slave-

dealing. Their language is spoken over a considerable area stretching south to the equator. The northern Gallas, nominally under Abyssinia, are partly Mohammedans, partly Christians; the southern Gallas are heathens. There are many tribes, generally under an elected chieftain.—**BIBLIOGRAPHY**: Stanford, *Africa* (vol. i); P. M. de Salviac, *Les Galla*.

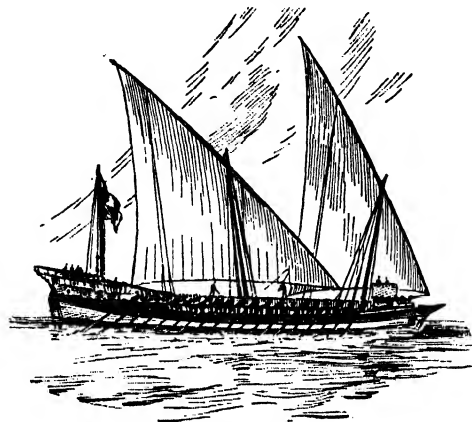
Gall-bladder is a pear-shaped sac situated on the under surface of the right lobe of the liver. It acts as a reservoir for the bile from the liver. Gallstones may accumulate in the gall-bladder and lead to serious results requiring surgical interference.

Galle (gal), a seaport near the south-west extremity of Ceylon, on a low, rocky projecting point of land. It is well built, has a good harbour, and fine scenery adjoining. It is a coaling-station for steamers, but has been superseded by Colombo as a port of call for mail steamers. Pop. 39,960.

Gal'ery, in architecture, a long, narrow room, the length of which is at least three times its width, often built to receive a collection of pictures. Among the most renowned European art galleries are those of the Louvre at Paris, that of Versailles, the National Gallery in London, the Pitti and Uffizi Galleries at Florence, the Dresden Gallery, the Real Museo of the Prado at Madrid, the Hermitage at Petrograd, the gallery of Berlin, the gallery of the Museo Borbonico at Naples, and those at Venice, Antwerp, and Turin. The term gallery is also sometimes applied to what is more properly termed a corridor, likewise to a platform projecting from the walls of a building supported by piers, pillars, brackets, or consoles, and, in churches, theatres, and similar buildings, to the upper floors going round the building next the wall. Among well-known glass-roofed galleries are those of Naples, Milan, Brussels, and of the Palais-Royal, Paris. In many German cities there are galleries which are really streets roofed with glass.

Galley, a low, flat-built vessel with one deck, and navigated with sails and oars, once commonly used in the Mediterranean. The common galleys varied from 100 to 200 feet in length, those of smaller sizes being known respectively as half-galleys and quarter-galleys. They carried as many as twenty oars on each side, each oar worked by one or more men, and they had commonly two masts with lateen sails. Raised structures in the stern, and even in the prow, were not uncommon. These, however, were more fully developed in the kind of galley known as the *galleass*, which carried three masts, from 200 to 300 rowers, and sometimes twenty guns. France formerly had a number of galleys for service in the Mediterranean, in which convicts were forced to labour. In the British navy galley is the name of the captain's boat, or a similar boat built for speed

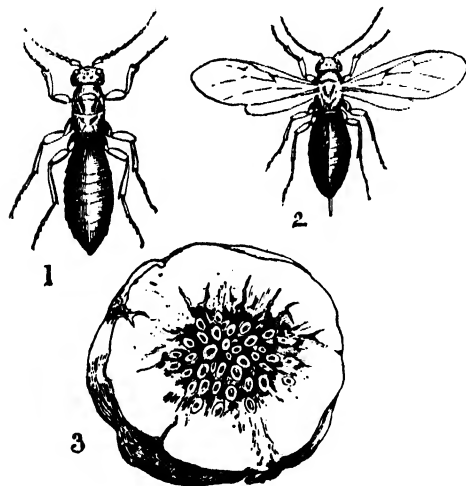
under oars. The term galley is also applied to the ships of the ancient Greeks and Romans, especially to their war-ships, which were pro-



Maltese Galley

pelled chiefly by oars.—Cf. Holmes, *Ancient and Modern Ships*.

Gall-fly, a name for several hymenopterous insects of the family Cynipidæ, which form the



Gall-fly

1, Wingless female (magnified). 2, Winged female, second generation (magnified). 3, Section of oak apple, showing grubs.

disease products known as galls, each species seeming to be addicted to a particular plant and a particular part of the plant. The tumour or gall is due to the morbid action of an irritating fluid deposited with the egg of the insect. Oaks are especially liable to attack. The well-known

'oak apple' is caused by *Cynips quercus folii*; 'oak spangles' on the backs of leaves are due to *Neuroterus fumipennis* and other species. The shrubby oak (*Quercus infectoria*) of Syria is attacked by *C. gallæ tinctoriæ*, which gives rise to the hard gall or gall-nut which is chiefly used in commerce. The hairy gall of the rose, called a *bedeguar*, is the work of *Rhodites rosæ*. The larvæ in this, as in the oak gall, do not come out till the following spring. See *Galls*.

Gallic Acid ($C_7H_6O_4$), an acid which derives its name from the gall-nut, whence it was first procured by Scheele in 1786. It exists in the seeds of the mango, has been found besides in many other plants, in acorns, colchicum, dividivi, hellebore root, sumach, tea, walnuts, &c., and is a decomposition product of tannic acid. It crystallizes in brilliant colourless prisms, with an astringent taste. It colours ferric salts of a deep bluish-black. It is of extensive use in the art of dyeing, as it constitutes one of the principal ingredients in all the shades of black, and is an important mordant. It is well known as an ingredient in ink, and when heated yields pyrogallol and carbon dioxide. See *Ink*; *Dyeing*.

Gallican Church, a distinctive name applied to the Roman Catholic Church in France. The peculiarity of the Gallican Church and of Gallicanism consists not in any diversity of doctrine or practice from those generally held and observed by Roman Catholics in other countries, but in the maintenance of a greater degree of independence of the Papal see, more especially by denying the validity of many of the decretals issued since the time of Charlemagne, and refusing to allow the Pope to interfere with the civil jurisdiction of the State and the sovereign rights of the Crown. The freedom asserted in this respect was increasingly recognized by the Pragmatic Sanctions of 1200 and 1438, and was still more clearly established by the Quatuor Propositiones Cleri Gallicani (Four Propositions of the French Clergy), drawn up in convocation by the French clergy in 1682. These were: (1) The Pope in secular matters has no power over princes and kings, and cannot loose their subjects from allegiance to them. (2) He is subject to the decrees of a general council. (3) His authority in France is regulated by fixed canons and the laws and customs of the kingdom and Church. (4) In matters of faith his decision is not unalterable (*irreformable*). During the Revolution the Gallican Church practically disappeared, and though Napoleon extorted from Pius VII a concordat for its re-establishment, no agreement was arrived at as to its organization. With the return of the Bourbons the bishops deprived by Napoleon were restored, and a new concordat concluded in 1817; but its unpopularity led the Government to exact from ecclesiastics an ex-

pression of adherence to the articles of 1682. The July revolution in 1830 gave full freedom to all denominations, and a clause was inserted in the Constitutional Charter expressly declaring that each person professes his religion with equal liberty, and obtains for his worship the same protection. Subsequently, and especially since the Vatican Council of 1870, the position of the Gallican Church towards the Popes has essentially changed, and the older Gallicanism may now be said to be represented by the Old Catholics of France. See *France*.—BIBLIOGRAPHY: Jervis, *The Gallican Church and the Revolution*; Le Roy, *Le Gallicanisme au XVIII^e siècle*; P. Sabatier, *France To-day: its Religious Orientation*.

Gallieni, Joseph Simon, French soldier, born at St. Bât, in Haute-Garonne, 24th April, 1840, died 26th May, 1916. Educated at St. Cyr, he fought in the Franco-German War, and was sent in 1878 to Senegambia, where he extended French influence. He afterwards served in the Sudan and in Tongking. In 1896 he was appointed Governor-General of Madagascar, and was raised to the rank of general of division in 1899. During the European War, in the critical days of Aug., 1914, when the French Government had to leave the capital for Bordeaux, Gallieni was appointed military governor of Paris, and organized the defence of the city. Appointed Minister of War on 28th Oct., 1915, he remained in office only a few months. Retiring on 17th March, 1916, he died at Versailles two months afterwards. On the 12th April, 1921, the Chamber of Deputies conferred upon him posthumously the title of *Maréchal de France*. He wrote: *Deux campagnes au Soudan Français, La Pacification de Madagascar*.

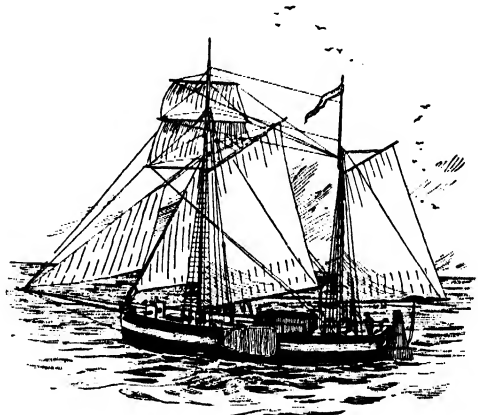
Gallienus, Publius Licinius, a Roman emperor, associated with his father Valerianus until the capture of the latter by the Persians in A.D. 260, when Gallienus continued to reign alone. His empire was limited by the revolt of most of the legions in the provinces, who chose their commanders as Cæsars, and thus gave rise to the period known as the 'Time of the Thirty Tyrants'. Though given up to pleasure, he defeated the Goths in Thrace and Postumus in Gaul, and forced Aureolus, whom the legions of Illyria had proclaimed emperor, to take refuge in Milan. While making preparations to reduce that town, he himself was assassinated A.D. 268.

Galliffet, Gaston Alexandre Auguste, Marquis de, Prince de Martignes, French general, born in Paris 23rd Jan., 1830, died in 1909. Entering the army in 1848, he fought with distinction in the Crimea, in Italy in 1859, and in Mexico in 1863. During the Franco-Prussian War he commanded the 3rd Chasseurs d'Afrique, and distinguished himself by his cavalry charge at Sedan. The Commune having been declared in

Paris, Galliffet was sent to suppress the rising, and employed the most rigorous measures and frightful severity to the Communard prisoners. This severity was subsequently the subject of continual bitter attacks upon him. He was made a member of the Superior War Council in 1885, but retired and entered the Chamber of Deputies in 1894. He was War Minister in 1899 in Waldeck-Rousseau's Cabinet.

Gal'linule (Lat. *gallinula*, dim. of *gallina*, hen), a name for aquatic birds belonging to the family Rallidæ or rails, genera *Gallinula* and *Porphyrio*. They are good swimmers, though they are not web-footed, but have the toes furnished with a narrow membrane. The common gallinule, moor-hen, or water-hen (*G. chloropus*), is the only British species, and it has a wide range through Europe, Asia, and Africa. It is black, with a red frontal shield. Allied species are found in most parts of the world, *Porphyrio* including handsome blue birds native to Africa and Madagascar, and also ranging from the Mediterranean region to South China and Polynesia.

Gal'liot (O.Fr. *galiote*), a Dutch or Flemish vessel for cargoes, with very rounded ribs and



Galliot. Early nineteenth century

flattish bottom, with a mizzen-mast placed near the stern, carrying a square main-sail and main-top-sail, a forestay to the main-mast (there being no foremast), with forestay-sail and jibs.

Gallip'oli (ancient *Callipolis*), a seaport of Southern Italy, in the province of Lecce, on a rocky peninsula in the Gulf of Taranto, 47 miles south-east of Taranto. It is fortified, and has a cathedral, dating from 1629, a productive tunny fishery, and a good harbour, from which large quantities of olive-oil are exported. Pop. 30,000.

Gallip'oli (ancient *Callipolis*), a town of

Greece, formerly belonging to Turkey, on a peninsula of the same name at the north-east end of the Dardanelles, 128 miles w.s.w. of Constantinople. It was once fortified, but is now in a generally dilapidated condition, with no edifice of note except the bazaars. It has manufactures of cotton, silk, and morocco leather, and two harbours, one formerly used as a station for the Turkish fleet, and the other for trade, chiefly in corn, wine, and oil. It was the gate by which the Turks entered Europe (1357), and in the Crimean War the Allied forces landed there (1854). Pop. about 25,000.

Gallipoli Campaign. After Turkey had entered the European War on the side of the Central Powers on 29th Oct., 1914, it was at first considered possible to secure the passage of the Dardanelles—and thus open communication with Russia—by means of a purely naval bombardment, which duly took place early in 1915, commencing on 15th Feb. When it became evident that this attempt was doomed to failure, it was abandoned in favour of a combined naval and military operation, in which an army was to land on the Gallipoli Peninsula supported by the guns of the Allied fleets.

This army was to consist, as did the fleet, of combined British and French formations, and the original force which carried out the actual landing was composed of a French division of Territorials and Senegalese under General d'Amade, the British 29th Division of the Regular Army, the Royal Naval Division, and the Australian and New Zealand Army Corps. All told this force numbered some 120,000 men. The harbour of Mudros, in the Island of Lemnos, had for some little time been used by the navy as a base, and here supplies and munitions were brought in huge quantities, nothing whatever being procurable locally; this place had now to serve as the base for the combined force, and it was here that the transports carrying the Expeditionary Force made their rendezvous, and from here that they started at midnight of the 24th–25th April, 1915, *en route* for the selected landing-places on the Peninsula. These landing-places were six in number, and the principal ones were known as 'V' Beach, 'W' Beach, 'X' Beach, and Gaba Tepe. The landings were to take place at dawn. The troops selected for 'V' Beach were the Dublin Fusiliers, the Munster Fusiliers, two companies of the Hampshire Regiment, and the West Riding Field Company, Royal Engineers; the greater part of these were on the collier *River Clyde*.

At 'W' Beach the Lancashire Fusiliers and the Worcester Regiment landed, and at 'X' Beach the Royal Fusiliers and some of the Anson Battalion, R.N.D. Gaba Tepe, afterwards known as Anzac, some 8 miles N.E. of

Beach 'Y' on the Ægean side, was reserved for the Australians and New Zealanders. The French Expeditionary Corps landed at Kum Kale, on the Asiatic side of the straits. In addition to these landings there were two smaller beaches on the Peninsula where troops also landed, known as 'Y' and 'S'.

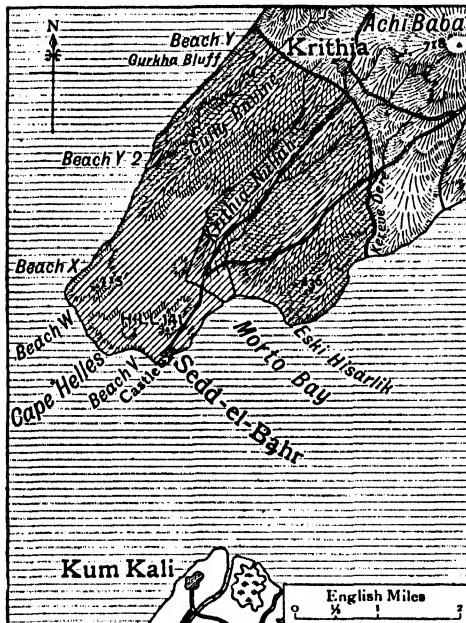
The net result of the various landings was the establishment of a British line across the very point of the peninsula. Then followed the advance on Krithia, wherein the Expeditionary Force was assisted by long-range fire from H.M.S. *Queen Elizabeth*.

From 1st to 4th May was fought the first battle of Krithia, a succession of attacks and counter-attacks, and after a lull of two days the second battle of Krithia began on 6th May. This had as a possible ultimate objective the heights of Achi Baba, and resulted in an advance by the 29th Division and the French—who had by now landed troops at 'V' Beach—of some 1000 yards.

From the 9th to 10th May there was very heavy fighting at Gaba Tepe or Anzac, wherein General Bridges, commanding the Anzac Corps, was killed. Small advances also took place elsewhere. On 4th June, after some days of varying successes and reverses, a further general attack on Krithia was begun. This, known as the third battle of Krithia, was carried out by the 29th, 42nd (arrived since the landing), and Royal Naval Divisions, and the French, and resulted in a gain of 500 yards. On the 21st the French gained ground on the right, and on the 27th the British divisions executed a brilliant piece of work near Krithia, capturing several lines of trenches and fortified posts, and almost succeeding in turning the Achi Baba position. This operation was the means of adding another 1000 yards depth to our territory.

The month ended with the repulse of heavy Turkish attacks at Anzac and a further French success on the right. The Allies were now in crying need of reinforcements, which, though they were on their way, had not yet materialized. The want of them made impossible a further most necessary attack in force, which might conceivably have had decisive results: wanting these reinforcements, the most the Allies could do was to hold on to what they had gained until the arrival of fresh troops made a new venture feasible. In the meanwhile a very heavy Turkish attack was defeated by the 29th and Royal Naval Divisions, and for the rest of the month attacks and counter-attacks succeeded each other without any outstanding results. By the end of the month the British losses were given as nearly 50,000 to date, while the Turks were said to have lost 20,000 (killed and prisoners) in the space of five days' fighting.

Early in August the long-expected reinforcements had arrived at the base, and the time was ripe for putting a new plan into execution. This was to land troops at Suvla Bay (north of Anzac) to deal with the Turkish right, while the Anzacs struck at their centre, and the English and French Divisions dealt with their left. The surprise landing duly took place at Suvla on 6th Aug., but, though the landing was made good, the plan in its entirety proved a costly failure, and resulted in little but very heavy losses, the attack finally dying away on the 12th.



Map showing approximately the area in the Southern Zone evacuated in Jan., 1916

Nine days later a second attempt was made from Suvla—the immediate objective being Anafarta—but with no better success.

Early in September the Turks attempted a night attack in force on the Australians near Anafarta, but were repulsed with very heavy losses. For the remainder of the month operations were mainly confined to artillery and aircraft, the Turks having strengthened their positions by denuding their fortresses at Adrianople and Chatalja of their heavy armament. During this month the 10th British and the French Divisions were withdrawn, and the question of complete evacuation was being discussed by the Cabinet, and in November Lord Kitchener made a tour of the southern front to see for himself and advise. In the meanwhile Sir Charles Monro

had replaced Sir Ian Hamilton as Commander-in-Chief in Gallipoli on 16th Oct.

During November—on the 15th—the 156th Brigade of the 52nd Division made a highly successful attack on the Turkish position. This, brilliant feat as it was, could not alter the general state of affairs, and the final decision to evacuate was taken. Casualties up to the end of November had been 112,000, besides sick; and on 20th Dec., almost eight months to the day since the original landings, Suvla and Anzac were evacuated under cover of an attack from Cape Helles. Losses in this evacuation were three men wounded. By the 9th Jan., 1916, the evacuation of the Peninsula was completed by the withdrawal from Cape Helles of the remaining troops with only one casualty. It was, of course, impossible to remove all the stores and munitions which had accumulated on the various beaches, and before evacuation they were prepared for burning, and it is said that the blaze created when they were lighted was the first intimation the Turks had of our withdrawal. However this may be, the fact remains that the withdrawal and embarkation of a large army from open beaches and without casualties shows a marvellous organization.

The official dispatches dealing with this campaign were published in London as follows: 5th July (Hamilton); 4th Aug. (De Robeck, naval); 20th Sept. (Hamilton); 6th March, 1916, (Monro). Casualties up to 11th Dec., 1915, were officially given as 25,000 all ranks dead, 75,000 wounded, 12,000 missing. In addition there was much sickness, no fewer than 96,000 having been admitted to hospital.—Cf. Sir Ian Hamilton, *Gallipoli Diary*.

Gallipoli Oil, a coarse olive-oil used in Turkey-red dyeing and for other purposes, and prepared from olives grown in Calabria and Apulia, the latter being considered the best. The oil is conveyed in skins to Gallipoli, where it is clarified and shipped in casks.

Gal'tium, a rare malleable metal, discovered by spectrum analysis in 1875 by De Boisbaudran in the zinc-blende of Pierrefitte in the Pyrenees. It is of a bluish-white colour, has a brilliant lustre, and is fused by the mere warmth of the hand. In its properties it is related to aluminium.

Galliwasp, the *Celestus occiduus*, a species of lizard about 1 foot in length, and remarkably stout and plump. Its general colour is brown. It is a native of the West Indies, and is particularly common in Jamaica, where it is much dreaded, though without reason.

Gallon, a standard measure of capacity (fixed in 1824 by Act of George IV), containing 277·27384 cubic inches, being equal to 4 quarts or 8 pints. In England formerly three different gallons were in use, the old corn-gallon of 268·8 cubic inches, the old wine-gallon of 231 cubic

inches, and the old beer-gallon of 282 cubic inches. The gallon of 231 cubic inches has been adopted as the standard of the United States.

Galloway, a district in the south-west of Scotland, now regarded as embracing Wigtownshire and Kirkcudbright, and returning one member to Parliament. It has given name to a breed of horses and one of cattle.

Galls, gall-nuts or nut-galls, a vegetable excrescence produced by the deposit of the egg of an insect in the bark or leaves of a plant. The galls of commerce are produced by a species of *Cynips* (see *Gall-fly*) in the tender shoots of the *Quercus infectoria*, a species of oak abundant in Asia Minor, Syria, and Persia. They are spherical and tubercular, and vary in magnitude from the size of a pea to that of a hazel-nut. White, green, and blue varieties are recognized, the latter kinds being the best. They are inodorous, but are strongly astringent from the



Oak-galls

1, 2, Galls from *Quercus infectoria* (Aleppo).
3, Transverse section.

tannin and gallic acid which they contain, and which are their chief products. Gall-nuts are extensively used in dyeing and in the manufacture of ink, and they are also frequently used in medicine. They are chiefly imported from Aleppo, Tripoli, and Smyrna. The Chinese galls, or *woo-pei-tsze*, differ from the foregoing in that they are really an unusually massive kind of crust or cocoon, such as the aphides form on the surface of a plant; the tissues of the plant are not affected. Since the opening of the Japanese ports these have been imported in considerable quantities to Britain.

Gallstones. See *Calculus*.

Galsworthy, John, British novelist and playwright, was born at Coombe, Surrey, in 1867. He was educated at Harrow, and New College, Oxford, where he took a second class in the jurisprudence schools. He was called to the Bar in 1890, but did not practise much. His career as author may be said to have begun with the publication of a volume of tales, called *The Villa Rubein*, in 1900. His best-known novels and tales are: *The Island Pharisees* (1904), *The Country House* (1907), *The Dark Flower* (1915), *Beyond* (1917), *Five Tales* (1918), *Saint's Progress* (1919), *Awakening* (1920), and *Tatterdemalion* (1920). His plays include: *The Silver Box* (1906), *Joy* (1907), *Strife* (1909), *Justice*

(1910), *The Pigeon* (1912), and *The Skin Game* (1920). Many of his stories and some of his plays deal with country gentlemen and their attitude towards life. He is intensely interested in social problems, and has published two collections of essays, *A Sheaf* (1916) and *Another Sheaf* (1919), dealing with questions of the day. His plays are well-constructed, and also deal in a sincere manner with contemporary problems. *The Silver Box* exposes some of the weaknesses of our system of administering justice, and *Strife* is concerned with the question of the relationship between masters and men. Galsworthy declined the honour of knighthood in 1918. In 1919 he delivered a series of lectures in America on Anglo-American questions; they were published under the title of *Addresses in America*.

Galt, Sir Alexander Tilloch, son of John Galt, the novelist, born in 1817, died 1893, a Canadian financier and statesman. He entered the Canadian Parliament in 1849, was Minister of Finance of the Dominion of Canada in 1867, and represented Canada on the Halifax Fishery Commission in 1877. From 1880 to 1883 he was High Commissioner of the Dominion in England.

Galt, John, Scottish novelist, born at Irvine in Ayrshire in 1779, died in 1830. He went to London in 1804, printed an epic on the *Battle of Largs*, and tried both commerce and the legal profession; but, failing in each, went abroad for some years. On his return in 1812 he published his *Voyages and Travels*, his *Letters from the Levant*, a *Life of Cardinal Wolsey*, and a volume of tragedies. He then became a contributor to the *Monthly Magazine* and other periodicals, and wrote a tragedy, *The Witness*, a *Life of Benjamin West*, and a romance—*The Wandering Jew*. His *Ayrshire Legatees* (1820), with its humorous descriptions of Scottish middle and low life, indicated the true scope of his faculty, and it was followed by his *Annals of the Parish* (1821), *The Provost* (1822), *Sir Andrew Wyllie* (1822), and *The Entail* (1823). These were perhaps his best works, though his writings comprised about fifty novels, twenty dramas, and other works. He went out to Canada as superintendent to the Canada Company in 1826, founded the town of Guelph, and returned in 1829.

Galton, Sir Francis, English traveller and anthropologist, grandson of Erasmus Darwin, and cousin of Charles Darwin, was born near Birmingham in 1822, died in 1911. He received his earlier education at King Edward's School, Birmingham, and afterwards studied medicine at the Birmingham Hospital and King's College, London. After graduating at Trinity College, Cambridge, he travelled to the White Nile, and subsequently (1850-2) explored Damaru- and Ovampo-lands, then unknown countries. He published an account of his experiences in his

Narrative of an Explorer in Tropical South Africa, and received one of the gold medals of the Royal Geographical Society. His *Art of Travel, or Shifts and Contrivances in Wild Countries* (1855), went through five editions in seventeen years. He was a member of the Meteorological Council from its formation in 1868 until 1901, and his *Meteorographica* (1863) contained much original work in this branch of science. From 1869 he devoted himself largely to questions connected with heredity, and published the following important works: *Hereditary Genius: its Laws and Consequences* (1869); *Experiments in Pangenesis* (1871); *English Men of Science: their Nature and Nurture* (1874); *Inquiries into Human Faculty and its Development* (1883); *Natural Inheritance* (1889); *Finger Prints* (1893); and *Finger Print Directory* (1895). He wrote also *Essays in Eugenics* (1909), and published *Memories of my Life* (1908). He was knighted in 1909. In 1886 he received the Royal Society's gold medal, and in 1902 the Darwin medal, besides similar honours.

Galvani, Luigi, Italian physician and physiologist, born at Bologna 1737, died 1798. He practised medicine in Bologna, and was in 1762 appointed professor of anatomy at the university. He gained reputation as a comparative anatomist; but his fame rests on his theory of animal electricity, enunciated in the treatise *De Viribus Electricitatis in Motu Musculari Commentarius*, published in 1791. Twenty years before the publication of this treatise he had been making experiments on the relations of animal functions to electricity. In 1797 he was deprived of his chair for refusing to take the oath of allegiance to the Cisalpine Republic, but was restored to it in less than a year. See *Galvanism*.

Galvanic Battery. See *Voltaic Cell*.

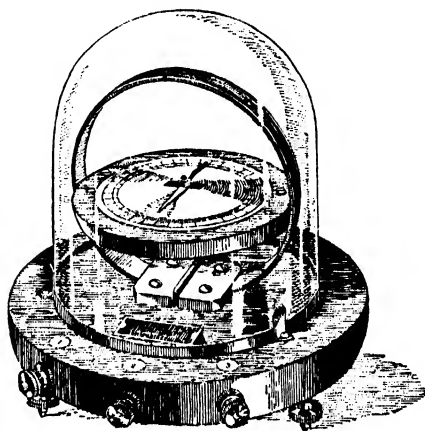
Galvanism, the production of electricity by means of the galvanic battery. The name is derived from Galvani, professor of anatomy at Bologna, who observed that the limbs of a dead frog could be caused to move by the contact of metals. His experiments attracted the attention of Volta, professor of natural philosophy at Pavia, who shortly afterwards invented the galvanic or voltaic battery.

Galvanized Iron, a name given to sheets of iron coated with zinc by a non-galvanic process, the iron being first cleansed by the action of dilute sulphuric acid, and then plunged into a bath of melted zinc covered with sal ammoniac. So long as the coating is entire, and so long as it is not exposed to corrosive substances, galvanized iron is very durable, and it is capable of resisting the corrosive action of the atmosphere.

Galvanometer, an instrument employed to detect and measure electric currents. The term

is generally confined to those laboratory instruments which depend for their action on the electromagnetic effect of the current.

Tangent Galvanometer.—The simplest form of current-measuring instrument consists of a circular coil of wire of one or more turns of known radius, with a compass-needle pivoted at the centre of the coil. The instrument is set up with the plane of the coil vertical and in the magnetic meridian. On passing a current through the coil, the needle is deflected from its position of rest: the strength of the current is proportional to the tangent of the angle of deflection. To find the absolute strength of the current, the tangent of the deflection is multiplied by the

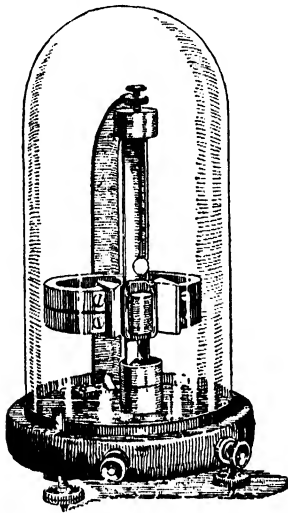


'Tangent Galvanometer'

galvanometer constant, a number found by dividing the product of the earth's horizontal magnetic field and the radius of the coil by 2π times the number of turns of wire in the coil ($\pi = 3.1416$ nearly). The current thus measured is in absolute units, and these are converted into amperes by multiplying by 10. For accuracy, a short needle is required; the angle of deflection is read off a circular scale, divided in degrees, by means of a long light pointer fixed to the needle at right angles to its length. The *Sine* and *Heinholtz* galvanometers are modifications of the above form.

Reflecting Galvanometer.—A more sensitive current detector is made by largely increasing the number of turns of wire in the coil, and by using an optical method of measuring the angle of deflection. The 'needle' consists of several short lengths of thin watch-spring, tempered and magnetized, and cemented to the back of a light circular mirror about a centimetre in diameter. The mirror is suspended by a strand of silk at the centre of the coil, with the short magnets

horizontal and with like poles to the same side. The position of the needle is found by reflecting the rays of a glow-lamp from the mirror to a horizontal scale pasted or etched on a strip of ground glass placed about 1 metre in front of the mirror. If the mirror is slightly concave, a sharply defined, vertical line of light is focussed on the scale. A control magnet is placed near the instrument to regulate the zero position of the 'spot of light', and to neutralize part of the magnetic control of the earth on the needle. On passing a weak current through the galvanometer, the needle is deflected, and the spot of light moves along the scale; since the reflected



Dead-beat D'Arsonval Reflecting Galvanometer

beam turns through twice the angle turned through by the mirror, and is also equivalent to a pointer 1 metre long, a very small deflection of the needle system may be detected. By passing a current of known strength through the galvanometer, and observing the deflection of the spot of light, it can be found how many microamperes are required to deflect the spot of light through one division of the scale when at 1 metre distance from the mirror. This number is called the figure of merit or sensitiveness of the galvanometer. The instrument was devised and used by Thomson (Lord Kelvin) during the laying of the Atlantic cable. It is subject to disturbance by external magnetic forces, a disadvantage from which the next type is free.

Moving-coil Galvanometer.—The moving system is a small coil suspended between the poles of a strong, permanent horse-shoe magnet. The current is led to and from the coil by means of wires above and below, which also hold the coil

in position and supply the forces which control the rotation of the coil. When the suspended coil carries a current, it becomes a magnet whose axis is perpendicular to the lines of force of the permanent magnet, and it rotates into a position in which the forces causing rotation are balanced by the effect of torsion in the suspending wires. The deflection of the coil is measured, as previously described, by lamp, mirror, and scale, or in some cases by means of a pointer and scale. The motion of the coil is practically 'dead-beat', i.e. the spot of light moves to its position of rest without swinging to and fro about that position like a compass-needle. Some forms of this instrument have a sensitiveness of about $\frac{1}{100}$ th microampere per division on a scale at 1 metre distance.

String Galvanometer.—The moving coil is replaced by a flexible vertical silvered glass fibre or 'string' fixed at its ends. When the current is passed through the string, the latter moves across the lines of force in the air-gap between the poles of the magnet. The poles are perforated in the direction of the lines of force, and a microscope, which fits into one perforation, is focussed on the string; the eyepiece of the microscope contains a scale on which the deflection of the string may be measured. This type was invented by Einthoven, of Leyden, and is capable of detecting currents of the order of a sixty-thousandth of a microampere.

Ballistic Galvanometer.—The construction of this instrument is similar to that of the reflecting galvanometers, except that the needle or moving-coil is made relatively much heavier. The galvanometer is used primarily for measuring quantities of electricity by noting the throw of the spot of light caused when the electricity is discharged through the galvanometer. With a slowly moving system, it may be assumed that the discharge is complete before the system has moved appreciably from its zero position. It can then be shown that a quantity of electricity, whose discharge causes a throw of the moving system through α° , is proportional to the sine of $\frac{1}{2}\alpha$. In practice a lamp, mirror, and scale are used, and the sensitiveness of the instrument is found by discharging a known quantity of electricity through it and noting the resultant throw of the spot of light. The sensitiveness is expressed by the number of microcoulombs required to cause a throw of one scale division at 1 metre distance. The galvanometer is employed to determine the magnetic field strength in the pole-gaps of electromagnets and dynamos, and the magnetic quality of steel; it is also used for comparing the E.M.F.'s of cells and the capacities of condensers. See *Ammeter*.—Cf. S. P. Thompson, *Electricity and Magnetism* (1915).

Gal'veston, a city and seaport of Texas,

United States, at the north-east extremity of Galveston Island, at the mouth of Galveston Bay, about 450 miles south by west of New Orleans. It is one of the most flourishing ports in the Gulf of Mexico. Large quantities of cotton are shipped, the export being over 3 million bales annually. The chief buildings are the custom and market houses, the town hall, a number of churches, including a Gothic Episcopal church and Roman Catholic cathedral, and the Roman Catholic University of St. Mary. Immense loss of life and damage to property was caused by a hurricane in 1900. Pop. 50,000.

Gal'way, a seaport of Western Ireland, province of Connaught, capital of county of same name, at the mouth of the Corrib, in Galway Bay, 117 miles west of Dublin. It consists in its older parts of narrow, irregular streets with antique houses, crowded with a pauper population; in the more modern parts it is spacious and well built. Besides numerous churches and chapels it has three monasteries and five nunneries. The town house and county hall and University College are amongst its best buildings. The manufactures are insignificant, and the trade, though once important, is no longer worthy of its excellent harbour. The chief exports are agricultural produce and marble. There are mills for sawing and polishing marble, a brewery, and a distillery. Galway was a parliamentary borough until 1918. Pop. 13,255.

Galway, the county, which is washed by the Atlantic, has an area of 2375 sq. miles, of which one-eighth is under crops. In the north-west, or district of Connemara, it is rugged and mountainous; in the east, level but extensively covered with bog; and in the south, fertile and tolerably well cultivated, producing wheat, barley, and oats. Lough Corrib, which lies wholly within it, dividing the county into the east and west districts, is the third largest lake in Ireland. The minerals include lead, limestone, marble, and beautiful serpentine. The fisheries are valuable, but much neglected. The principal manufactures are coarse woollens and linens. In 1918 the county returned four members to Parliament. Pop. 182,224.

Galway Bay, a large bay on the west coast of Ireland, between County Galway on the north and County Clare on the south, about 30 miles in length and from 20 to 7 miles in breadth. Across its entrance lie the Aran Islands, and there are numerous small islands in the bay itself.

Gama, Dom Vasco da, the first navigator who made the voyage to the East Indies by the Cape of Good Hope, was born in 1450 at Sines, Portugal, of a noble family, died in 1524. His voyage had been projected under John II, and his successor, Emmanuel the Fortunate,

having fitted out four vessels, appointed Gama commander-in-chief. He sailed from Lisbon on 8th July, 1497, and, doubling the Cape, visited Mozambique, Mombaza, Melinda, and Calicut, returning to Lisbon in 1499. For this exploit he was named Admiral of the Indies and received the title of Dom, with an annual pension and extensive privileges in Indian commerce. In the year 1502 he was placed at the head of a powerful fleet, with which he provided for the security of future voyagers by founding establishments at Mozambique and Sofala. He also inflicted signal reprisals on the town of Calicut, where the Portuguese residents had been massacred, and established the first Portuguese factory in the Indies. He re-entered Lisbon in 1503, and passed the next twenty years in obscurity. In 1524 he was appointed Viceroy of India by King John III, but his administration lasted only three months, his death taking place at Goa in the December of that year.—Cf. G. Correa, *The Three Voyages of Vasco da Gama and his Viceroyalty* (Hakluyt Society Publications).

Gama'iel, the name of two men mentioned in Bible history, of whom the first, Gamaliel, the son of Pedahzur (*Num.* i, 10; ii, 20; vii, 54, 59; x, 23), was prince or head of the tribe of Manassch. The other and better-known Gamaliel is mentioned twice in the *Acts of the Apostles*, as a learned doctor of the law, of the sect of the Pharisees. From *Acts*, xxii, 3 we learn that he was the preceptor of St. Paul; the other reference (*Acts*, v, 34) records his famous advice to the Sanhedrin as to their treatment of the Apostles. According to tradition Gamaliel became a Christian, and was baptized by St. Peter and St. Paul.

Gambet'ta, Léon Michel, a French orator and statesman, born in 1838 at Cahors, of a family of Genoese extraction, died in 1882. He was educated for the Church, but finally decided in favour of the law, and, repatriating to Paris, became a member of the Metropolitan Bar in 1859. In Nov., 1868, he gained the leadership of the Republican party by his defence of Delescluze, a noted republican. In 1869, having been elected by both Paris and Marseilles, he chose to represent the southern city; and in the Chamber of Deputies showed himself an irreconcilable opponent of the empire and its measures, especially of the policy which led to the war with Prussia. On the downfall of the empire, after the disaster of Sedan in 1870, the Government of National Defence was formed, in which Gambetta was nominated Minister of the Interior. The Germans having encircled Paris, he left that city in a balloon, and set up his head-quarters at Tours, from which, with all the powers of a dictator, he for a short time organized a fierce but vain resistance against the invaders.

After the close of the war he held office in several short-lived ministries, and in Nov., 1881, accepted the premiership. The sweeping changes proposed by him and his colleagues speedily brought a majority against him, and after a six weeks' tenure of office he had to resign. The accidental discharge of a pistol caused his death at Paris on 31st Dec., 1882. On the 11th of Nov., 1920, the anniversary of the armistice concluded with Germany after the European War, the heart of Gambetta was brought to Paris in solemn procession and interred in the Pantheon.—BIBLIOGRAPHY: J. Reinach, *Léon Gambetta*; F. Harrison, *Léon Gambetta, a Positivist*; P. B. Gheusi, *Gambetta: Life and Letters*; P. Deschanel, *Gambetta*.

Gambia, a British colony and protectorate in West Africa, forming a narrow strip running through French territory, and stretching inland from the mouth of the River Gambia on both sides; total area, 4500 sq. miles; capital, Bathurst. Ground-nuts (the main product), rubber, hides, and bees'-wax are exported; and cottons and rice imported. Pop. 200,000.

Gambia, a river of West Africa, rising in a mountainous district in Futa Jallon and flowing north-west and west to the Atlantic, through French and British territory; length, about 700 miles. It is navigable for 300 miles by small vessels, and is an important highway for the British colony of Gambia.

Gambier Islands, a group of small coral islands in the South Pacific, about lat. 23° 8' s. and long. 134° 55' w.; belonging to France. The vegetation is luxuriant, and there are numerous birds but no indigenous quadrupeds. A French mission station was formed on the largest island, Mangareva, in 1834. Pop. about 1533.

Gambir (*Uncaria Gambir*), a climbing shrub of the Malay Archipelago, ord. Rubiaceæ, the leaves and twigs of which yield, when boiled, the genuine catechu or terra japonica, a powerful astringent substance, used medicinally and for tanning.

Gambling, or **Gaming**, the practice of indulging in games involving some element of chance or hazard with a view to pecuniary gain. In many countries such games, and the collateral practices of betting on events or taking shares in lotteries, are legally prohibited or restricted as frequently associated with fraud and as themselves demoralizing. At other times Governments, tempted by the prospect of gain, have openly encouraged gambling by licensing gaming-houses, or instituting lotteries under their own authority. (See *Lottery*.) In France public gaming-tables were suppressed from 1st Jan., 1838, but lotteries are still sometimes carried on. Previous to the formation of the former German Empire gambling was encouraged in both of the ways referred to in several of the

principalities of Germany. Baden-Baden, in the former Grand-Duchy of Baden, and Homburg, in Hesse-Homburg, were the two most famous resorts in Europe of the frequenters of gaming-tables. After the formation of the empire in 1871 gaming was suppressed in these places (31st Dec., 1872), and since that time the principality of Monaco has become the last public resort of this species of gambling.

In Great Britain gaming has been the subject of numerous enactments. Henry VIII made proclamation against certain games, including dice, cards, and bowls, and prohibited the keeping of any common house for unlawful games under penalties of 40s. per day for keeping the house, and 6s 8d. per time for playing in it. By an Act of Charles II (1663) any person fraudulently winning money by gaming is to forfeit treble the amount, and any person losing more than £100 at cards or dice on credit at one sitting is not bound to pay, and the winner forfeits treble the amount. Under Anne all notes, bills, and bonds given for money won by gaming were decreed void, and any person paying a loss of more than £10 might recover it within three months as a common debt; or if the loser did not sue, any other person might do so. In the reign of William IV such notes were declared void between the parties, but not in the hands of purchasers or endorsers. By Acts of George II keepers of public-houses were punishable for permitting gaming, and the games of faro, hazard, roulette, and all other games with dice, except backgammon, are prohibited under penalties. An Act of 1845, while repealing some of the previous Acts, and exempting games of mere skill, including billiards and dominoes, inflicts the penalty of £100 (afterwards increased to a maximum of £500) on any person keeping a gaming-house, with the alternative of six months' imprisonment. Cards and other games may of course be played in private houses, but not in gaming-houses, or in such a way as to constitute a nuisance. Persons playing or gaming in public places may be punished as rogues and vagabonds. Penalties are inflicted for keeping billiard or bagatelle tables without a licence. Lotteries and raffles are illegal (but art union lotteries are excepted). Persons fraudulently winning money by gaming shall be deemed guilty of obtaining it by false pretences. No suit-at-law can be brought against a loser for money won at play or to recover money so lost, or to recover a deposit from a stakeholder; but this does not apply to prizes at any lawful sport. Later Acts provide that betting-houses shall be considered gaming-houses. The present state of the law in Great Britain is defined by the Street Betting Act of 1906. (See *Betting*.) Any person found in a gaming-house who shall give a false name or

address is liable to a fine of £50.—Cf. W. Coldridge and C. V. Hawksford, *The Law of Gambling, Civil and Criminal*.

Gamboge (from *Camboja* or *Cambodia*), a concrete, vegetable, inspissated juice or sap, or gum-resin, yielded by several species of trees. The gamboge of European commerce appears to be mainly derived from *Garcinia Hanburii*, a diocious tree with handsome laurel-like foliage and small yellow flowers, found in Cambodia, Siam, and in the southern parts of Cochin-China. This substance is contained chiefly in the middle layer of the bark of the tree; it is obtained by incision, and issues in the form of a yellowish fluid, which, after passing through a viscid state, hardens into the gamboge of commerce. It consists of a mixture of resin with 15 to 20 per cent of gum. Gamboge is used in painting, staining, and lacquering. As a drug it has drastic purgative properties, but is seldom administered alone. In doses of a dram or even less it produces death. Other species of *Garcinia* yield a similar drug. The so-called American gamboge is the juice of *Vismia guianensis* and other South American species.

Game Laws, laws relating to the killing of certain wild animals pursued for sport, and called game. Formerly in Britain certain qualifications of rank or property were needed to confer the right to kill game; but this was altered by the Game Act of 1831, and now anyone is qualified to kill game who has taken out a proper inland revenue licence, and every one must hold such a licence whether he is to kill game on his own land, or on that of another with his permission. The law differs somewhat in England, Scotland, and Ireland, but the animals specially designated as game are hares, pheasants, partridges, grouse, black-game, and bustards; while hares and rabbits are also spoken of as 'ground game'. No one is allowed to kill winged game during a part of the year called the *close season*, which for partridges begins on 2nd Feb. and ends on 31st Aug., for pheasants is from 2nd Feb. to 30th Sept., for grouse from 11th Dec. to 11th Aug., for black-game from 11th Dec. to 19th Aug. The close-season was established for humanitarian reasons, to allow the birds to breed; but the season ends on different days for different birds merely to enable sportsmen to have an abundance and a variety of game. Hares are also protected during the months March–July. Any person killing game on Sunday or Christmas Day is liable to a fine of £5. Generally, a game licence is also necessary to enable a person to kill deer, woodcocks, snipe, quails, landrails, and rabbits. A person who kills game without a licence is liable to a penalty of £20 (for breach of the excise laws). Whoever trespasses by day in pursuit of game, or any of the

above-mentioned animals (though he may possess a game licence), is liable to the fine of £2, and when five or more go together each is liable to the penalty of £5. Night-poaching is a graver matter; the first offence renders the guilty party liable to imprisonment with hard labour for three months, and to find security for good behaviour. The duties on licences for killing or dealing in game are excise duties, and are regulated as follows: for a licence to each person for taking or killing any game whatever, if taken after 31st July and before 1st Nov., to expire on 31st July following, £3; if to expire on 31st Oct. of the same year, £2; from 1st Nov. to 31st July, £2; if for a continuous period of fourteen days alone, £1; licence to deal in game, £2. A person holding a game licence does not require a gun licence. By an Act of 1880 every occupier of land has a right, as inseparable from and incident to the occupation of the land, to kill and take ground-game (hares and rabbits) thereon, concurrently with any other duly authorized person, all agreements in contravention of this right being declared void. Game laws of greater or less strictness are in force in many other countries. In Canada and the United States the chief restrictions are in regard to killing wild animals during the breeding season.—**BIBLIOGRAPHY:** Warry, *Game Laws of England*; Marchant and Watkins, *Wild Birds Protection Act*; Oke, *Game Laws* (5th edition, 1912).

Games, a name of certain sports or amusements carried on under regular rules and methods, as with cards or dice, billiards, tennis, &c. Among the ancients there were public games or sports, exhibited on solemn occasions, in which various kinds of contests were introduced. The Grecian games were national festivals attended by spectators and competitors from all parts of Greece, the chief being the Olympic, Pythian, Nemean, and Isthmian. They consisted of chariot races, running, and wrestling and boxing matches, and victory in one of these contests was esteemed one of the highest achievements of a Greek citizen. The Roman games (*ludi*) were held chiefly at the festivals of the gods. They might, however, be exhibited by private persons to please the people, as the combats of gladiators, theatrical representations, and combats of wild beasts in the amphitheatre. See also such articles as *Athletic Sports*; *Billiards*; *Chess*; *Cricket*; *Football*; &c.; also *Children's Games*.

Gametes, in botany, a general term denoting sexual cells, such as the spermatozoids or ova of Ferns and other oogamous plants, or the two similar cells (isogametes) which conjugate with one another in the case of *Spirogyra* or *Mucor*. See *Ferns*; *Zygote*.

Gametophyte, the phase in the life-history of a plant which terminates with the production

of gametes, e.g. the Moss-plant or the prothallus of a Fern.

Gamopetalous Flowers, those which have the petals cohering, as the primrose, foxglove, deadnettle, &c., in fact, all such as belong to the sub-class known as gamopetalous or sympetalous Dicotyledons.

Gam'ut, or **Gammüt**, in music, the entire series of musical tones in the natural order of ascent or descent. With the musicians of the eleventh century A represented the lowest note in their instruments, and a lower note having been introduced, the Greek gamma (Γ) was taken to represent it. From its prominent place as first note of the scale its name was taken to represent the whole. This system of musical notation was invented in the tenth century by Guido Arezzo, a Benedictine monk.

Gandak', or **Gunduck**, a river of Northern Hindustan, rising in the Himalayas and entering the Ganges; length, 400 miles.

Gandamak', a place in North-Eastern Afghanistan, where a treaty with Britain was signed in 1879. See *Afghanistan*.

Gandia, a town and port of Spain, in the province and 34 miles south by east of Valencia, on the Alcoy. It is walled and well built, with a handsome Gothic church and a fine palace of the Dukes of Gandia. Pop. 11,659.

Gando, a former sultanate of the Western Sudan, intersected by the Niger, and inhabited chiefly by Fellatahs, with a capital of the same name. It is most fertile, and has a pop. of about 5,500,000. Mohammedanism is the prevalent religion. Since 1898 the territory has been merged in the colonies of Nigeria, and in Dahomey and Upper Senegal.

Ganesa (ga-nā'sa), an Indian god, the son of Siva and Pārvati, represented by a figure half man half elephant, having an elephant's head. He is the god of prudence and good luck, and is invoked at the beginning of all enterprises. There are not many temples dedicated to him, and he has no public festivals, but his image stands in almost every house.



Ganesa

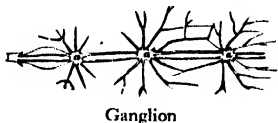
Ganges (gan'jez), a river of Hindustan, one of the greatest rivers of Asia, rising in the Himalaya Mountains, in Garhwāl state, and formed by the junction of two head-streams, the Bhagi-

rathi and the Alaknanda, which unite at Deoprag, 10 miles below Srinagar, 1500 feet above sea-level. The Bhagirathi, as being a sacred stream, is usually considered the source of the Ganges, rising at the height of 13,800 feet, but the Alaknanda flows farther and brings a larger volume of water to the junction. At Hardwar, about 30 miles below Deoprag, the river fairly enters the great valley of Hindustan, and flows in a south-easterly direction till it discharges itself by numerous mouths into the Bay of Bengal, after a course of about 1700 miles. During its course it is joined by eleven large rivers, the chief being the Jumna, Son, Ramganga, Gumti, Gogra, Gandak, and Kusi. In the rainy season the flat country of Bengal is overflowed to the extent of 100 miles in breadth, the water beginning to recede after the middle of August. The Ganges delta has the Hugli on the west, the Meghna on the east, and commences about 200 miles, or 300 miles by the course of the river, from the sea. Along the sea it forms an uninhabited swampy waste, called Sunderbunds, or Sundarbans, and the whole coast of the delta is a mass of shifting mud-banks. The westernmost branch, the Hugli, is the only branch commonly navigated by ships. The Meghna, or main branch, on the east is joined by a branch of the Brahmaputra. Some of the principal cities on the Ganges and its branches, ascending the stream, are Calcutta, Murshedabad, Bahar, Patna, Benares, Allahabad, Cawnpore, and Faruckabad. The Ganges is navigable for boats of a large size nearly 1500 miles from its mouths, and it forms a great channel for traffic. It is an imperative duty of the Hindus to bathe in the Ganges, or at least to wash themselves with its waters, and to distribute alms, on certain days. The Hindus believe that whoever dies on its banks, and drinks of its waters before death, is exempted from the necessity of returning into this world and commencing a new life. The sick are therefore carried to the bank of the Ganges, and its water is a considerable article of commerce in the remoter parts of India.

Ganges Canal, Upper, a lateral canal in Northern India (United Provinces), constructed for purposes of irrigation and supplementary navigation, extending on the right of the Ganges from Hardwar to Cawnpore.—The *Lower Ganges Canal* is a sort of continuation of the Upper, intended for irrigation purposes. The Upper Canal was opened in 1854, and the Lower Canal in 1878. The total length is about 700 miles, and the total cost of the works has been about £5,000,000.

Gang'lion, in anatomy, an enlargement occurring somewhere in the course of a nerve, and containing nerve cells in addition to nerve filaments. There are two systems of nerves which

have ganglia upon them. First, those of common sensation, whose ganglia are near to the entry of the nerve into the spinal cord. Secondly, the great sympathetic nerve, which has ganglia on various parts of it. In the invertebrates ganglia form the central nervous system, and are distributed through the body in pairs, one for each ring of the body, connected by fibres as in the figure. The cerebral ganglia of vertebrates are the brain itself, and the masses of grey matter at the base of the brain, as the optic thalamus.



Ganglion

Part of the nervous system of the larva of a beetle (*Calosoma sycophanta*). a a, Ganglia.

Gangpur, a native state of Bengal, in Chota Nagpur, consisting mainly of hills, forest, and jungle; area, 2402 sq. miles; pop. 74,000.

Gangrene is the death of a considerable area of body tissue. It is known as dry gangrene when the tissues involved were previously drained of fluid, and moist gangrene when the part is full of fluid. In the latter condition putrefaction frequently appears, as the moisture is favourable to the growth of putrefactive germs. Amputation or removal of the affected part is necessary. Anything that lowers or destroys the vitality of living tissues favours the development of gangrene, as seen by its appearance in certain diseases, in the senile and debilitated, or following the application of certain substances to the skin.

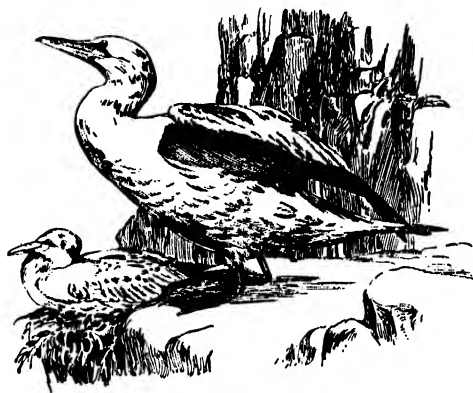
Gangway, a narrow platform or bridge of planks along the upper part of a ship's side for communication fore and aft; also a sort of platform by which persons enter and leave a vessel. —In the House of Commons the gangway is a passage across the House, which separates the Ministry and Opposition with their respective adherents, who sit on seats running along the sides of the House, from the neutral or independent members, who occupy seats running across. Hence, the phrase *to sit below the gangway*, as applied to a member, implies that he holds himself as bound to neither party.

Ganister, or **Crowstone**, a hard sandstone found in Yorkshire, Derbyshire, Lancashire, &c., mainly in association with the Lower Coal Measures. Ground down, it is used to make furnace-hearths, and, mixed with clay, to line Bessemer converters.

Ganjam, a town of India, in the Madras Presidency, formerly capital of the district of same name, near the coast of the Bay of Bengal. It was at one time a flourishing place; but the town declined after the epidemic of 1815, when Berhampur became the head-quarters. The prin-

cipal arm of the Ganjam River, which enters the sea to the south of the town, is about one-third of a mile broad.—The district, one of the five Circars, is one of the most productive under the Madras Presidency, yielding rice, cotton, sugar, rum, and pulse. Area, 8313 sq. miles; pop. 1,896,803.

Gannet, the solan goose, a bird of the genus *Sula* (*S. bassana*), the type of a family (Sulidæ) of aquatic birds, related to cormorants and pelicans. It is about 3 feet in length, and 6 feet in breadth of wings from tip to tip; the whole plumage a dirty white, inclining to grey; the eyes a pale yellow, surrounded by a naked skin of a fine blue colour; the bill straight, 6 inches long, and furnished beneath with a kind

Gannet (*Sula bassana*)

of pouch. The gannets are birds of passage, arriving in Great Britain about March and departing in August or September, their movements being partially determined by those of the herring, on which they feed. They migrate to the southward in the winter, and appear on the coast of Portugal. In the breeding season they retire to high rocks on unfrequented islands—the Hebrides, Orkneys, St. Kilda, Ailsa Craig, and the Bass Rock. The nests are generally formed of sea-weed. The female lays only one egg, though, if it be removed, she will deposit another. The young, which are much darker than the old birds, remain in the nest until nearly their full size, becoming extremely fat. In St. Kilda they form part of the food of the inhabitants, being taken by men lowered from the top of the cliffs. A number of related species, known to sailors as 'boobies', range through the warmer parts of the ocean.—Cf. J. H. Gurney, *The Gannet: a Bird with a History*.

Gan'oids (Ganoidei), the second order of fishes according to Agassiz. This artificial group is now broken up into three distinct orders. The

species of this order are chiefly characterized by angular, rhomboidal, polygonal, or circular scales composed of horny or bony plates covered with a thick layer of glossy enamel-like substance. The ganoids were most numerous in Palæozoic and early Mesozoic times, but are now represented by eight genera: (1) *Crossopterygii*: *Polyp-térus*, the bichir, represented by a single species occurring in rivers of tropical Africa; *Calamoichthys*, the reed-fish, found in Old Calabar.

(2) *Chondrostei*: *Acipenser*, represented by the sturgeon; *Scaphirhynchus*, best known by the so-called shovel-nosed sturgeon of the Mississippi basin, but also represented in Eastern Asia; *Polyodon*, the paddle-fish of the Mississippi; and *Psephurus*, native to the great rivers of China. (3) *Holostei*: *Amia*, the bowfin (*A. calva*), common in the fresh waters of central and southern North America, and distinguished by the possession of flexible overlapping scales; *Lepidosteus*, including the garfish or bony pike of the North American rivers and lakes.

Gantung Pass, a wild pass in the Western Himalayas between Bussahir in the Punjab and Tibet. It is covered with perpetual snow, and is 18,295 feet in height.

Ganymede (-méd), in Grecian mythology, the son of Tros and of Callirrhœ, daughter of Scamander. Zeus sent his eagle to carry him off from Mount Ida to Olympus, where he held the office of cup-bearer to the immortals in succession to Hebe. He was also represented as the genius of the fertilizing and life-giving Nile.

Gaper-shell, a bivalve mollusc, the *Mya arenaria*, common on the British coasts. It has an oblong shell, and burrows in sand and mud, where it is sought after for bait. The otter shell (*Lutraria*) is closely related.

Gapes, a disease of fowls and other Rasorial birds, arising from the presence in the windpipe of small parasitic worms (*Fasciola trachealis*) which cause the bird continually to open its beak. They may be dislodged with an oiled feather, or by mixing a little Epsom salts with the food.

Gapon, Father, Russian priest and revolutionary, born at Biliki, government of Poltava, in 1870, died in 1906. On account of his revolutionary views he was not allowed by the Government of the Tsar to take charge of a parish.

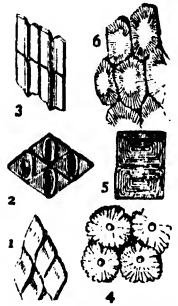
He became a prominent leader of the revolutionary movement in Russia in 1905, when the great strikes broke out and 12,000 Putilov workmen ceased work. Gapon led the deputation to Tsarskoe Selo to see the Tsar on the famous Red Sunday in 1905. He was saved by his friends and escaped to London, but subsequently disappeared, and it is still doubtful whether he committed suicide or was executed at Petrograd by the revolutionary party whom he had betrayed.—Cf. Gapon, *The Story of my Life*.

Gar'ancin, or **Garancine**, the product obtained by treating pulverized madder, previously exhausted with water, with concentrated sulphuric acid at 100° C. (212° F.), and again washing with water. The residue thus obtained is found to yield better results in dyeing than madder itself.

Garay (gá'ri), Janos, Hungarian poet, born in 1812, died blind in 1853. He studied at Pesth, where he held a minor post in the public library. His heroic poem *Csatár* (1834) was succeeded by a number of dramas, mostly historical, the chief being *Arbocz* (1837), *Országgy Ilona* (1837), and *Bátory Erzsébet* (1840). His cycle of historic ballads, showing Uhland's influence, was published in 1847, under the title *Arpádok*, and his lyric poems *Balaton-i Kagylok* (Shells from Lake Balaton) in 1843. His last work was an historical epic, *Szent László* (St. Ladislaus), published 1850.

Garbler, formerly an officer of the city of London, vested with power to enter any shop or warehouse to examine drugs and spices, and garble (i.e. sift out the coarse parts, dirt, &c.) and make clean the same, or see it done.

Garcilaso de la Vega (gár-thé-lá'só; properly **Garcias Laso de la Vega**), called the *prince of Spanish poets*, born at Toledo in 1500 or 1503, died in 1536. He went in his youth to the Spanish court, and in 1529 distinguished himself in the Spanish corps serving against the Turks in Austria. An intrigue with a lady of the court led to his imprisonment on an island in the Danube, where several of his poems were composed. In 1529 he was engaged in the expedition against Soliman, and in 1535 in that against Tunis. He was made commander of thirty companies of infantry in 1536, and accompanied the imperial army against Marseilles, but was mortally wounded in attempting to scale a tower near Fréjus. He died at Nice, and was buried at Toledo. His name is associated with that of his contemporary Boscan in the impetus given to Spanish literature by the imitation of the Italian poetic style as exemplified in Petrarch, Ariosto, and Samazaro. His works, which consist of eclogues, epistles, odes, songs, and sonnets, are graceful and musical. His poems were first published in 1543.



Scales of Ganoid Fishes

1. *Lepidosteus*. 2. *Cheiracanthus*. 3. *Palæoniscus*. 4. *Cephalaspis*. 5. *Dipterus*. 6. *Acipenser*.

Garcilaso de la Vega, or **Garcías Laso de la Vega**, historian of Peru, surnamed the Inca, son of Garcilaso de la Vega, one of the conquerors of Peru, and a princess of the race of the Incas; born at Cuzco, Peru, in 1530 or 1540. Having fallen under the groundless suspicion of the Spanish Government, he was sent home in 1500, and died in 1616 or 1620. His great work on the history of Peru is in two parts: the first entitled *Los Comentarios Reales que tratan del Origen de los Incas* (Lisbon, 1609); the second, the *Historia general del Peru* (Cordova, 1616). He wrote also *Historia de la Florida* (Lisbon, 1609).

Garcinia, the genus of plants to which the mangosteen and gamboge belong, nat. ord. Guttiféræ.

Gard (gär), a department of Southern France, abutting on the Gulf of Lions; area, 2270 sq. miles. The north and west are occupied by the Cevennes and their branches, sloping gradually into a fertile plain, the coast-line of which is so low as to form extensive swamps and salines. The drainage belongs partly to the Garonne, but chiefly to the Rhône, which forms the east boundary. Within the department the chief river is the Gard. The rich lower districts produce a large quantity of wine, and are noted for silk-culture. Large quantities of salt are made; and lead, coal, iron, &c., are worked. There are silk, woollen, and cotton manufactures. Nîmes is the capital. Pop. (1921), 396,169.

Gard, Pont du, a fine Roman aqueduct, in Gard, 10 miles from Nîmes, joining two mountains, and passing over the Gardon. It has three tiers of arches, and is 160 feet high. See *Aqueduct*.

Garda, or **Bena'co**, **Lake** (It. *Lago di Garda*; the *Benacus Lacus* of the Romans), the largest lake in Italy, belonging to the Alpine region, 33 miles long north to south, 3 to 11 miles broad, greatest depth, 902 feet, 213 feet above sea-level. The Sarca, almost its only affluent, enters at its north end, and it is drained by the Mincio, which issues from its south-east end, near Peschiera. It is well stocked with fish. Steamboats ply on it, and its shores are covered with villas.

Gardaya (gär-dä'yä), or **Ghardaya**, name of a territory and of a town of Algeria, in the Sahara. The town is surrounded by a wall flanked with towers and entered by ten gates. Pop. of territory, 141,377; of town, 7868. See *Beni-Mzâb*.

Garde Écossaise (gärd ä-kos-äz), the Scottish guard in the service of the Kings of France, first instituted on a regular footing by Charles VII, who in 1453 selected a hundred Scottish archers to form a special body-guard in recognition of the service of the Scottish soldiery in the Hundred Years' War. There was also another company of a hundred Scots placed at the head of

a regular army of fifteen companies of 100 lances each, which was organized. This body was commanded by Scots of the highest rank. James VI, and his sons Henry and Charles, and James II when Duke of York, held in succession the rank of captain in it.

Garde Nationale (nä-syo-näl), a guard of armed citizens instituted at Paris on the 13th of July, 1789, for the purpose of preserving order and protecting liberty. At first it numbered 48,000 men, but was increased to 300,000 when it was organized throughout the whole country. Acting as a Royalist and reactionary force, it was crushed by Napoleon in 1795. It was reorganized by the Directory and by Napoleon, and again under the Bourbons, to whom, however, it was a source of such disquietude that it was dissolved by a Royal Ordinance in 1827. Under Louis Philippe it was resuscitated in its old form, and contributed to his overthrow. In 1851 the National Guard was again reorganized, but in 1855 it was dissolved. In 1870 the National Guard of Paris was again formed for the defence of the city against the Prussians. The resistance of a section of the guard to the decree of disarmament issued under M. Thiers led to the insurrection of the Commune, at the close of which the guard was declared dissolved by the National Assembly (1871).

Garde Nationale Mobile, a body constituted by Napoleon III in 1868, on the suggestion of Marshal Niel, to form bases of regiments to supplement the regular army. It was called into action in 1870-1, but was too badly organized to be efficient.

Garden Cities, the term for cities or centres of population which would have much garden-ground as one of their features. They are the expressed result of an attempt to remedy the evils of overcrowding in large towns, one means of starting them being by getting manufacturers to move their works out of the towns into the country, and erecting sanitary dwellings suited for their employees, care being taken to leave plenty of open spaces among the dwellings, thus combining the advantages of town and country. One of the earliest practical essays of the kind was the model village of Port Sunlight, not far from Birkenhead, erected by Messrs. Lever Bros. for their employees. Mr. George Cadbury subsequently placed an estate at Bournville, near Birmingham, in the hands of trustees, and expressed his willingness to advance his work-people and others money for building on right principles, a certain amount of land being for ever kept clear round each dwelling. Mr. Joseph Rowntree, early in 1905, established a Garden Village Trust at Earswick, near York; but the first Garden City proper is the outcome of a scheme outlined by Mr. Ebenezer Howard in

1898. An estate of nearly 4000 acres was acquired at Letchworth, near Hitchin, in 1903, by the Garden City Association, Ltd.; water and sewage arrangements were seen to at once, and the supply of roads, railway, gas, and other facilities followed. Several firms have moved their works there, and a number of well-to-do people have secured sites for residences. Each dwelling has its own garden, and roughly three-quarters of the estate is to be devoted, in perpetuity, to small holdings, parks, &c. A feature of many of these schemes and also of Garden Suburbs is provision for co-operative ownership and administration of the estates by the tenants.

An analogous movement is that for the erection of Garden Suburbs, which are not intended to be complete economic entities like Letchworth, but are designed to provide dwelling-places in healthy and beautiful surroundings on the outskirts of large cities and towns. The best-known Garden Suburb is that at Golders Green, which is built on an extension of Hampstead Heath, and is known as 'Hampstead Garden Suburb', but a number of other such suburbs are already in existence, and many of the local schemes to remedy the housing shortage felt in 1919 at the close of the European War are on Garden Suburb lines. A large scheme is now being carried out at Welwyn, in Hertfordshire. The success of the movement for building garden cities and suburbs must, however, be measured not only by the number of actual Garden Cities and Suburbs in existence, but also by the general improvement in the situation and design of artisan and middle-class houses which is already manifesting itself as a result of the growth of civic pride fostered by the movement, and also by the desire of private undertakers of building not to be outdone by the associations whose competition they now have to meet. The movement has spread from England to the Continent, and both France and Germany can show creditable examples of Garden Cities. The pioneers of the movement have been enabled to see, even in their own lifetime, a great improvement in the standard of living.—Cf. C. B. Purdom, *The Garden City*.

Gardenia, a genus of trees and shrubs, nat. ord. Rubiaceae, natives of tropical Asia and Africa, bearing beautiful white or yellowish flowers of great fragrance. *G. florida* and *G. radicans* are well known in Britain as Cape jasmine, though natives of Japan.

Garden-spider, also called *Diadem*, or **Cross-spider**, the *Epeira diadema*, a common British spider the dorsal surface of which is marked with a triple yellow cross. It forms a beautiful geometric web.

Garden-warbler (*Sylvia hortensis*), a migratory song-bird visiting Britain from the end of

April to September. It is rather less than 6 inches long, the head and upper surface greenish-brown, the under surface brownish-white.

Gardiner, Samuel Rawson, English historian, born in 1829, died in Feb., 1902. Educated at Winchester and Christ Church, Oxford, he was for some years professor of modern history at King's College, London, but resigned in 1885. He specially devoted himself to the period of English history beginning with the accession of James I, and gave a full and impartial account of the events of the time, based on the original documents. The first section comes down to the outbreak of the Civil War (1603–42), the second deals with the Civil War (1642–9), the third with the Commonwealth and Protectorate. He also wrote: *Cromwell's Place in History*, *Oliver Cromwell*, and a *Student's History of England*.

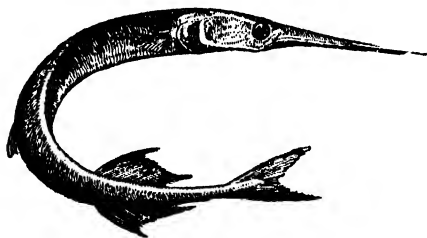
Gardiner, Stephen, an English prelate, son of John Gardiner, a cloth-merchant of Bury St. Edmunds. He was born in 1493 at Bury St. Edmunds, and died in 1555. In 1520 he took the degrees of D.D. and LL.D. at Cambridge, where he became master of Trinity Hall. He passed at this time by the name of Dr. Stephens. Having become secretary to Wolsey and a favourite with the king, he was dispatched to Rome in 1528 to forward Henry VIII's divorce, and on his return was appointed Secretary of State, and in succession Archdeacon of Norwich and Leicester, and Bishop of Winchester. He also went on various embassies to France and Germany. Although he supported the king in renouncing the authority of the Pope, he opposed the doctrines of the Reformation, and took an active part in the passing of the Six Articles and in the prosecution of Protestants. He was successful in contriving the fall of his opponent Cromwell, but failed to injure Catherine Parr, and fell into disfavour. During the reign of Edward he was imprisoned in the Fleet, deprived of his bishopric, and afterwards imprisoned in the Tower from 1548–53, but Mary restored him to his bishopric, and appointed him Lord Chancellor. He officiated at her coronation and marriage, became one of her chief advisers, and took an active part in the persecutions at the beginning of the reign, maintaining also the illegitimacy of Elizabeth. His works include: *De Vera Obedientia* (1534), a defence of the king's supremacy; *A Necessary Doctrine of a Christian Man* (1543); *Sacrament of the Altar* (1551); and some tracts.—BIBLIOGRAPHY: CASSAN, *Lives of the Bishops of Winchester*; R. W. Dixon, *History of the Church of England*.

Gardner, Ernest Arthur, English archæologist, born in London in 1862. Educated at the

City of London School and at Caius College, Cambridge, he explored in 1885 Naucratis, a Greek colony in Egypt, and was Craven student from 1887 to 1889. Director of the British School of Archæology at Athens from 1887 to 1895, he became Yates professor of archæology at University College, London. In 1910 he was elected first public orator of London University. His works include: *Introduction to Greek Epigraphy* (1887), *A Handbook of Greek Sculpture* (1896-7), *Ancient Athens* (1902), *The Inscriptions of Attica* (1905), *Religion and Art in Ancient Greece* (1910), *Six Greek Sculptors* (1910).

Garfield, James Abram, an American general and statesman, the twentieth President of the United States, born in Ohio on 19th Nov., 1831, died 10th Sept., 1881. He worked on a farm till his fourteenth year, but acquired a good education, studied law, and in 1859 was elected to the Ohio state Senate. In 1861 he entered the army, was appointed colonel, became chief of staff to Rosecranz, and major-general of volunteers. In 1863 he was elected to Congress and resigned his command. He sat in nine Congresses for the same constituency, serving on important committees, and winning ground no less by strong intelligence than uncompromising honesty. In 1880 he was elected to the Senate, and in the same year became President of the United States. Many reforms seemed about to be inaugurated, when he was shot by a disappointed office-seeker named Guitau, in the railway station at Washington. He lingered eighty days, dying at Long Branch.—Cf. Lossing, *A Biography of James A. Garfield*.

Garfish, *Sea-pike*, or **Gar-pike** (*Belone vulgaris*), a fish, known also as the *sea-needle*,

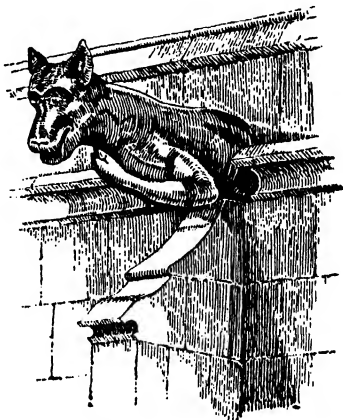


Garfish (*Belone vulgaris*)

making its appearance on the English coasts in summer, a short time before the mackerel. It is long and slender, sometimes 2 or 3 feet in length; the head projects forward into a very long, sharp snout; the sides and belly are of a bright silvery colour, and the back green, marked with a dark purple line. The bones are of a bright-green colour. The name Garfish or Gar-pike is also given to other species of *Belone*, and to a ganoid fish of the genus *Lepidosteus*,

found in the fresh waters of America. See *Bony-pike*.

Gar'ganey (*Anas querquedula*), a species of duck called also 'summer teal', from its habit of visiting Britain in summer, and from its close kinship to the common teal. It is widely spread through the eastern hemisphere.



Gargoyle, St. Cuthbert's, York. Fifteenth century

Garga'no (Lat. *Gargānus*), a group of pine-clad mountains in South Italy, province of Foggia, forming the spur of the boot in the Italian peninsula projecting into the Adriatic. The loftiest summit is Calvo, 5450 feet.

Gargan'tua, the hero of Rabelais' satire (*Gargantua and Pantagruel*), so named from his father exclaiming "*Que grand tu as!*" "How large (a gullet) thou hast!" on hearing him cry out, immediately on his birth, "Drink, drink!" so lustily as to be heard over several districts. It required 900 ells of linen for the body of his shirt, and 200 more for the gussets, 1100 cow-hides for the soles of his shoes, and he picked his teeth with an elephant's tusk. See *Rabelais*.

Gargle is a wash for the throat. To use a gargle about half a fluid ounce (one tablespoonful) of the fluid to be used should be taken into the mouth and, with the head well thrown back, allowed to pass into the throat. Air should then be expelled through the fluid to enable the fluid to come in contact with all the walls of the passage. Gargles are more effective in chronic throat conditions, and should not be used in very acute throat infections.

Gar'goyle, in Gothic architecture, a projecting spout for throwing the water from the gutter of a building, usually of some grotesque form, such as the head or figure of an animal or monster. Among famous gargoyles are those of Notre Dame in Paris.

Garhwál (*gar-hwál'*), or Gurhwal, a district

of India, in the United Provinces, bounded on the north by Tibet, east by Kumáun, south by Bijnaur district, and west by the Garhwal state; area, 5500 sq. miles; pop. 430,000. There are good roads, and a considerable trade with Tibet.

Garhwál, or Tehri, a native Indian state under British protection, west of the district of the same name; area, 4180 sq. miles; pop. 300,000. Chief town, Tehri; chief rivers, the Alaknanda and other headwaters of the Ganges. A large part is covered with forests, which include valuable *deodar* tracts, leased to the British Government in 1864.

Garhwáls, the inhabitants of a hilly tract of country in the Lower Himalayas, some 5500 sq. miles in extent, and bounded on the north by Tibet. Garhwáls are small lightly-built men, and furnish a two-battalion regiment—the 39th Garhwal Rifles—to the Indian Army. As soldiers they are intelligent, law-abiding, and loyal. By religion they are Hindus. Unlike the Gurkha, whom in some respects he resembles, the Garhwali is not much given to sport or voluntary exercise of any kind. He is, however, capable of standing great fatigue and showing the maximum of endurance on little food; moreover, he is exceptionally steady in danger. The Garhwali uniform is similar to that of the Gurkha Rifles, and, like them, they wear short knickerbockers leaving the knees bare, and slouch hats instead of the usual pagri or turban.

Garibal'di, Giuseppe, Italian patriot and hero, the son of a poor fisherman, was born at Nice 1807, and died on 2nd June, 1882. He got little education, and for a number of years was a sailor on various trading vessels. In 1834 he became a member of the 'Young Italy' party, and being condemned to death for his share in the schemes of Mazzini, escaped to Marseilles, took service in the fleet of the Bey of Tunis, and finally went to South America. In the service of the Republic of Rio Grande against the Brazilians he became known as a brilliant leader, and with his famous Italian legion he subsequently gave the Monte Videans such effective aid against Buenos Ayres as to earn the title of 'hero of Monte Video'. In 1848 he returned to Italy, raised a band of volunteers, and harassed the Austrians until the cessation of hostilities and re-establishment of Austrian supremacy in Lombardy. He then retired to Switzerland, but in the spring of 1849 proceeded to Rome to support Mazzini's republic. He was appointed to command the forces, but the odds were overwhelming, and after a desperate defence of thirty days Garibaldi escaped from Rome with 4000 of his followers. In the course of his flight his wife Anita died from fatigue and privations. He reached the United States, and was for some years in command of a mer-

chant vessel. He then purchased a part of the small Island of Caprera, off the north coast of Sardinia, and made this his home for the rest of his life. The subscriptions of his admirers enabled him afterwards to become owner of the whole island. In the war of 1859, in which Sardinia recovered Lombardy, Garibaldi and his Chasseurs of the Alps did splendid service; and on the revolt of the Sicilians in 1860 he crossed to the island, wrested it after a fierce struggle from the King of Naples, recrossed to the mainland and occupied Naples, where he was proclaimed Dictator of the Two Sicilies. It was now feared that Garibaldi might prove untrue to his motto—*Italy and Victor Emmanuel*—but he readily acquiesced in the annexation of the Two Sicilies to Italy, and, declining all honours, retired to his island farm. In 1862 he endeavoured to force the Roman question to a solution, and entered Calabria with a small following, but was taken prisoner at Aspromonte by the Royal troops. He was soon released, however, and returned to Caprera. In 1864 he received an enthusiastic welcome in Britain. In 1866 he commanded a volunteer force against the Austrians in the Italian Tyrol, but failed to accomplish anything of consequence. Next year he attempted the liberation of Rome, but near Mentana was defeated by the French and Pontifical troops, and was again imprisoned by the Italian Government, but soon pardoned and released. In 1870 he gave his services to the French Republican Government against the Germans, and with his 20,000 men rendered valuable assistance in the south-east. At the end of the war he was elected a member of the French Assembly, but speedily resigned his seat and returned to Caprera. Rome now became the capital of united Italy, and here in Jan., 1875, Garibaldi took his seat in the Italian Parliament. The latter part of his life was spent quietly at Caprera. His popularity with the British public led to the adoption by ladies of a species of blouse called a Garibaldi, more or less resembling the red shirt worn by the patriot. His autobiography was published in English in 1889.—BIBLIOGRAPHY; Bent, *The Life of Giuseppe Garibaldi*; R. Thurston, *Garibaldi and his Friends*; R. S. Holland, *Builders of Modern Italy*; G. M. Trevelyan, *Garibaldi and the Making of Italy*.

Garigliano (gá-ril-yā-nō), a river of South Italy, formed by the junction of the Liri and Sacco near Pontecorvo. After a course of 40 miles it falls into the Gulf of Gaëta; but if the Liri is regarded as the same stream, its length is more than double.

Garlic (*Allium sativum*), a hardy perennial allied to the onion, indigenous to the south of Europe, and forming a favourite condiment

amongst several nations. The leaves are grass-like, and differ from those of the common onion in not being fistulous; the stem is about 2 feet high; the flowers are white; and the root is a compound bulb, consisting of several smaller bulbs, commonly denominated *cloves*, enveloped by a common membrane. It has a strong, penetrating odour, and a pungent acrid taste. Used as a medicine it is stimulant, tonic, and promotes digestion; it has also diuretic and sudorific qualities, and is a good expectorant.—*Oil of garlic* is a sulphide of allyl, $(C_2H_5)_2S$, a colourless, strongly-smelling oil, exceedingly irritant to the palate and the skin. It is contained also in the onion, leek, and asafetida.

Garnet, a group of mineral silicates with a general formula of $R_3''R_2'''(SiO_4)_3$, R'' being iron, calcium, magnesium, or manganese, and R''' iron, aluminium, or chromium. Crystal form commonly the rhombic dodecahedron of the cubic system, often modified by other planes until it assumes almost a spherical form. *Almandine*, iron aluminium garnet, is a red species very common in argillaceous rocks altered by contact with granite, and occurring over wide areas in metamorphic rocks. When translucent, it forms part of the *precious garnet* used as a gem. *Pyrope*, magnesium aluminium garnet, is also known as precious garnet, and has been obtained in large quantities from Bohemia. The 'cinnamon stone' of Ceylon is *grossularite*, a yellowish or red-brown calcium aluminium garnet. *Uvarovite*, calcium chromium garnet, is emerald-green. The high hardness of garnet makes it suitable for a gem-stone.

Garnett, Richard, English writer, was born at Lichfield in 1835, died in 1906. He was the son of the Rev. Richard Garnett, Assistant Keeper of Printed Books in the British Museum. Entering the same department, he became Assistant Keeper of Printed Books in 1875, and Keeper in 1890, retiring in 1899. From 1875 to 1884 he was superintendent of the reading-room. He took an active interest in the library, and superintended the publication of the *General Catalogue of Printed Books*. In 1883 he received the honorary degree of LL.D. from Edinburgh University, and in 1895 he was made a C.B. Besides many articles in periodicals and encyclopædias, Dr. Garnett published *Primula: a Book of Lyrics* (1858); *Io in Egypt, and other Poems* (1859); *Poems from the German; Relics of Shelley; Idylls and Epigrams*, republished as *A Chaplet from the Greek Anthology; Iphigenia in Delphi; Sonnets from Dante, Petrarch, and Camoens; The Queen, and other Poems*; in fiction, *The Twilight of the Gods, and other Tales* (1888); *Lives of Carlyle, Emerson, Milton, and E. G. Wakefield; The Age of Dryden* (1895); *William Blake, Painter and Poet* (1895); *History of English*

Literature (with Edmund Gosse); *History of Italian Literature; Essays in Librarianship and Bibliography* (1899); *Essays of an Ex-Librarian*, &c., besides numerous works which he edited.

Garnierite, a green mineral, a hydrous silicate of magnesium and nickel, forming an important ore of nickel in New Caledonia.

Garnishment (O.Fr. *guarnir*, *warnir*; Eng. to warn). This is an order at the instance of a creditor inhibiting a third party who is known as 'the garnishee', and who is in possession of goods belonging to the debtor, or is himself indebted to the debtor, from handing over the goods or making payment of the money pending a settlement of the creditor's claim. Its purpose is to enable the goods or money to be made available for satisfaction of the debt in the event of the debtor's default. Should judgment have been obtained against the debtor, the order is known as a 'garnishee order'. It is granted by the court upon an *ex parte* application supported by an affidavit setting forth the fact that judgment has been obtained against the debtor and has not been satisfied. The garnishee may show cause why the order should not be implemented, but failing due cause shown he must make payment into court, such payment operating as a discharge *pro tanto* by the debtor in favour of the *garnishee*. Any debt in which the debtor has a beneficial interest and for which he may competently sue may be thus attached, including debts due to a corporation and money in bank other than money on deposit in the Post Office Savings Bank. The following, however, are not attachable: (a) unliquidated damages; (b) dividends in a voluntary winding-up of a limited liability company or in a bankruptcy; (c) the half pay of naval and military officers; (d) the wages of seamen or sea-apprentices, servants, labourers, or workmen; and (e) future income of a tenant for life.

Garofalo, Benvenuto (properly *Benvenuto Tisio da Garofalo*), an Italian historical painter, born at Ferrara in 1481. He painted at Cremona, at Rome, where he became intimate with Raphael, and at Bologna, and finally returned to Ferrara, where he died blind in 1559. His work shows the influence of the Lombard school and still more of Raphael, though he was more than an imitator of the latter. Examples of his work are to be found in Ferrara, Florence, Rome, London, and Dresden.

Garó Hills, a district of India, forming the south-western corner of Assam; area, 3270 sq. miles. It is a mountainous and forest region intersected by tributaries of the Brahmaputra. The native Garos are a robust and active race. Among them the wife is regarded as the head of the family, and property descends through females. Pop. about 140,000.

Garonne' (Lat. *Garumna*), a river of S.W. France, rising in the Vale of Aran, in the Spanish Pyrenees; length, about 350 miles. It enters France and flows north-west to the Atlantic, through Haute-Garonne, Tarn-et-Garonne, Lot-et-Garonne, and Gironde. Below Toulouse it receives, on the left, the Save, Ratz, Gers, and Baise; on the right, the Tarn, the Lot, and the Dordogne, on joining which it changes its name to the Gironde. It is navigable on the descent from St. Martory, and both ways from Toulouse. The Canal du Midi, joining it at Toulouse, forms a communication between the Atlantic and the Mediterranean at Narbonne, and the Canal Latéral, from Toulouse to Castets-en-Dorthe (Gironde), supplements its direct navigation.

Garonne, Haute, a department, south of France, one of the five separated by the Pyrenees from Spain. It is traversed from south to north by the higher reaches of the Garonne and for about 26 miles by the Canal du Midi. The valleys and the lower northern districts are often of great fertility, and cereals and wine are largely exported. Hemp, flax, oranges, and tobacco are also much grown. The principal mines are lead, copper, coal, antimony, iron, and zinc, and a fine marble is quarried. There is a large trade with Spain. Capital, Toulouse. Area, 2457 sq. miles. Pop. (1921), 424,482.

Garrick, David, actor, born at Hereford, 19th Feb., 1717, died 20th Jan., 1779. His grandfather was a French refugee, his father a captain in the army. He was educated at Lichfield Grammar School, spent a short time at Lisbon with an uncle, and, returning to Lichfield, was placed under Samuel Johnson, who was induced to accompany him to the metropolis (1737). Garrick then began to study for the law, but on the death of his father joined his brother Peter in the wine trade. He had, however, as a child, a strong passion for acting, and in 1741 he joined Giffard's company at Ipswich under the name of Lyddal. At Giffard's theatre in Goodman's-fields he achieved a great success as Richard III, and in 1742 was not less successful at Drury Lane. In 1745 he became joint manager with Thomas Sheridan of a theatre in Dublin, and after a season at Covent Garden (1746) purchased Drury Lane in conjunction with Lacy, opening it 15th Sept., 1747, with the *Merchant of Venice*, to which Dr. Johnson furnished a prologue. From this period may be dated a comparative revival of Shakespeare, and a reform both in the conduct and licence of the drama. In 1763 Garrick visited the Continent for a year and a half. He had already written his farces of *The Lying Valet*, *Lethe*, and *Miss in her Teens*; and in 1766 he composed, jointly with Colman, the excellent comedy of *The Clandestine Marriage*. After the death of Lacy, in 1773, the sole manage-

ment of the theatre devolved upon Garrick, until 1776, when he sold his moiety of the theatre for £37,000, performed his last part, Don Felix in *The Wonder*, for the benefit of the theatrical fund, and bade an impressive farewell to the stage. He was buried with great pomp at the foot of Shakespeare's statue in Westminster Abbey. Besides the pieces mentioned he wrote some epigrams, a number of prologues and epilogues, and a few dramatic interludes. As a man Garrick was highly respected, the chief defect of his character being vanity. As an actor he has probably never been excelled, and he was almost equally great both in tragedy and in comedy. He left a large fortune. The Garrick Club was founded in London in 1831 by Francis Mills. T. W. Robertson's well-known play *David Garrick* (1864) is of course mere fiction. It is based upon Mélesville's three-act comedy *Sullivan*, Robertson having with questionable taste substituted a real for an imaginary hero.—BIBLIOGRAPHY: *Lives* by P. Fitzgerald, J. Knight, and James Smyth; Boaden, *The Private Correspondence of David Garrick*; Mrs. Parsons, *Garrick and his Circle*; F. A. Hedgecock, *A Cosmopolitan Actor: David Garrick and his French Friends*.

Garrison, William Lloyd, American journalist and founder of the anti-slavery movement in the United States, born 1805, died at New York in 1879. He was apprenticed to a shoemaker, but eventually became a compositor on the *Newburyport Herald*. In 1827 he became editor of the *National Philanthropist*, the first American temperance journal, and afterwards of a journal in support of the election of John Quincy Adams. With Mr. Lundy, a Quaker, he then started the paper called the *Genius of Universal Emancipation* (1829), his denunciations of slave-traders leading to his imprisonment for libel. On his release he commenced lecturing in Boston, and started the *Liberator* (1831), published weekly with the aid of one assistant and a negro boy. In 1832 appeared his *Thoughts on African Colonization*, and in the same year he established the American Anti-Slavery Society. He subsequently visited England, where he was welcomed by Wilberforce, Brougham, Buxton, and others. In 1835 he was saved with difficulty from a Boston mob; but his principles made steady progress until 1865, when the Anti-Slavery Society was dissolved with its work accomplished. A volume of sonnets (1843) and one of selections (1852) bear his name. Some of his sonnets were pencilled on the walls of his Baltimore cell in 1830.—Cf. Goldwin Smith, *The Moral Crusader*, W. L. Garrison.

Garrot, the French name for ducks of the genus *Clangula*, having the bill shorter than the head, widely distributed over the temperate regions of Europe and America. The golden-

eye (*C. glaucion*) is a common species in Britain, its general colour being white beneath, with head and sides of neck rich green, back and tail bluish or greyish-black, and the bill bluish-black. It has a round white spot before each eye, and two white bands on the wing; the female is ashy, with rufous head; length of male, about 19 inches. Related American species are the buffle-headed duck (*C. albeola*) and Barrow's duck (*C. islandica*), the latter ranging into Greenland and Iceland.

Garrote (gár-rō'tā), a Spanish method of execution by strangulation, the victim being placed on a stool with a post or stake (Sp. *garrote*) behind, to which is affixed an iron collar with a screw. The collar is made to clasp the neck of the criminal, and is drawn tighter by means of the screw till life becomes extinct. This word, with the French spelling and pronunciation *garrotte*, has become naturalized in Great Britain as a term for a species of robbery effected by throttling the victim and stripping him while insensible. In 1803 flogging was added to the usual penalty for the offence of garrotting.—Cf. W. Andrews, *Bygone Punishments*.

Garrya, a genus of opposite-leaved evergreen shrubs, natives of California, Mexico, Cuba, and Jamaica. *G. elliptica* is a handsome garden plant with long drooping necklace-like catkins of pale-yellow flowers.

Garshin, Viévolod Mikhailovitch, Russian novelist, born 2nd Feb., 1855, in the government of Ekaterinoslav, died 24th March, 1888, at Petrograd (St. Petersburg). He entered the School for Mining Engineers but soon left it, and in 1877 enlisted as a volunteer in the army sent to Turkey during the Russo-Turkish War. Wounded and transferred to Kharkov, he completed his first story, *Four Days* (begun in Bulgaria), wherein he described the suffering and fancies of a wounded soldier left behind on the battlefield. This work was followed by *A Very Small Novel*, *An Accident*, *The Coward*, *The Meeting*, *The Artist*, *Altalca Princeps*, and *The Night*. Garshin belonged to the school of Dostoevsky, and, like the latter, he was given to psychological analysis and excelled in the exposition of conflicting emotions. Inclined to melancholy from his early youth, he was insane for a time. He subsequently recovered, but his mind remained unbalanced until the end, when in a fit of insanity he killed himself. His other works include *The Red Flower* and *Nadejdna Nikolaevna*.

Garstang, an ancient English market town, North Lancashire, on the Wyre, 11 miles south of Lancaster. Lying on the Great North Road, it used to be an important place in the coaching days. Pop. (urban district), 10,753 (1921).

Garter, Order of the, the highest and most

ancient order of knighthood in Great Britain. The origin of the order, though sometimes assigned to Richard I, is generally attributed to Edward III, the legend being that the Countess of Salisbury having dropped her garter while dancing, the king restored it, after putting it round his own leg, with the words, which became the motto of the order, "*Honi soit qui mal y pense*"—"Shame be to him who thinks evil of it". The date of the foundation or restoration by Edward III of the order, as given by Froissart, is 1344, while other authorities, founding on the statutes of the order, assign it to 1350. The statutes of the order have been repeatedly revised, more particularly in the reigns of Henry V, Henry VIII, Edward VI, and George III—the last in 1805. Ladies are said to have been admitted up till the reign of Edward IV. Until the reign of Edward VI the common title of the order was the Order of St. George, and it still bears this title, as well as that of the Garter. The original number of knights was twenty-six, including the sovereign, who was its permanent head; and this number is still retained, except that by statutes passed in 1786, 1805, and subsequently, princes of the blood, sovereigns and princes of other realms, and extra knight companions may be admitted as supernumerary members. The peculiar emblem of the order, the garter (5), made of dark-blue velvet edged with gold, bearing the motto and with a gold buckle and pendant, is worn on the left leg below the knee. The mantle is of blue velvet, lined with white taffeta; the surcoat and hood of crimson velvet; the hat of black velvet, with plume of white ostrich feathers, having in the centre a tuft of black heron's feathers. The collar of gold (3) consists of knots alternating with garters enclosing roses, with the badge of the order, called the George (4), pendant from it. This consists of a figure of St. George on horseback fighting the dragon. The lesser George (2) is worn on a broad blue ribbon over the left shoulder, resting on the right hip. The star (1), formerly only a cross, is of silver, and consists of eight points, with the cross of St. George in the centre, encircled by the garter. A star is worn by the knights, on the left side, when not in the dress of the order. The officers



Insignia of the Garter

of the order are the Prelate, the Bishop of Winchester; the Chancellor, the Bishop of Oxford; the Registrar, Dean of Windsor; the Garter King of Arms, and the Usher of the Black Rod. There are a dean and twelve canons, and each knight has a knight-pensioner. The Sovereign of the order is always the King of England, and the number of members in 1921 was forty.—Cf. Sir H. Nicolas, *History of British Orders of Knighthood*.

Garter King of Arms, the head of the heraldic establishment in England, consisting of three kings of arms—Garter, Clarenceux, and Norroy, and the herald of the Most Noble Order of the Garter. The office of Garter King of Arms was instituted by Henry V in 1417. The duties of the Garter King of Arms are principally to grant heraldic supporters, to arrange royal funerals, and to present the Order of the Garter to foreign princes.

Garth, Sir Samuel, English physician and poet, born in 1661, educated at Peterhouse, Cambridge; M.D. in 1691, after studying at Leyden; made a Fellow of the College of Physicians, 1693. A division among the medical profession on the establishment of a dispensary for the metropolitan poor was the occasion of his successful mock-heroic poem *The Dispensary* (1699). He became the chief Whig physician, as Radcliffe was chief Tory physician, and on the accession of George I was knighted, and appointed physician in ordinary to the king, and physician-general to the army. He died in 1719. He wrote much in verse and prose, including translations.

Gas Manufacture. The word 'gas' was coined by the Dutch chemist J. B. Van Helmont, but, as he himself states, it was suggested by the Greek *chaos*. Many gases of different kinds have now been discovered by the labours of the chemists, but the particular one with which we are now concerned is that which is obtained from coal. This is a colourless, pungent, and inflammable essence composed mainly of carbon and hydrogen, those elements taking the form, broadly speaking, of fats, oil, wax, and wood.

There are two chief kinds of gas used for fuel. The first and most common is 'town's gas', which is composed entirely of coal-gas, or partly of coal-gas and partly of water-gas, which may or may not be carburetted with oil-gas; and the second is natural gas, which is not known in England except in very small quantities. The first is made by man; the second, as the name implies, is produced by Nature herself. There are many large wells of natural gas in different parts of the United States and Canada, but these are already showing signs of exhaustion. 'Town's gas', on the other hand, has, of course, the advantage over natural gas that the supply

is not inconstant, but can, in normal times, and given an adequate supply of the raw material, be regulated to meet the demand.

It is necessary to give certain simple chemical facts in regard to coal-gas. It has a specific gravity of 0.44, and it is made up as follows:—

Hydrogen	48.40	Combustible and illuminant.
Marsh gas or methane .. .	35.00	
Light-yielding hydrocarbons, ..	3.83	
Carbon monoxide	6.61	
Carbon dioxide	0.12	Inert gases.
Nitrogen	5.05	

When mixed with air in the proportion of one part of gas to anything from five to fifteen parts of air, it becomes explosive. If there be less than five parts of air, the mixture will burn, not explode; while if it contain more than fifteen parts of air, it is too weak either to burn or explode.

As coal-gas is lighter than air it is found useful for inflating balloons in cases where hydrogen is too expensive. This characteristic of lightness, or volatility, accounts for the fact that all gas-works are built in the lowest-lying parts of a town.

Van Helmont, who lived in the first quarter of the seventeenth century, was the first to apply the word 'gas' to the vapours known before his time by scientists under the generic term of *Spiritus Silvestris*. Later in the seventeenth century Van Helmont's experiments were repeated in the United Kingdom by that great natural philosopher Robert Boyle. His chief work in this sphere of inquiry was to distinguish between the effect of combustion and distillation, and in 1680 he proved that 'air' could be produced by artificial means, and collected in a condition unmixed with ordinary atmospheric air. Other earlier experimenters were Thomas Shirley, who discovered near Wigan a well of 'natural' gas, and the Rev. John Clayton, D.D., who was the first to discover that gas could be distilled from crude coal and afterwards stored in vessels. Dr. Clayton communicated the results of his experiment to Robert Boyle, but neither he nor his more famous philosophical correspondent seems to have suspected the industrial possibilities of this sun's essence, and they left the matter where they found it, in the realm of theory.

It remained for de Gensanne to describe, in the year 1770, the distillation of coal for industrial purposes, as applied at the ironworks belonging to the Prince of Nassau-Saarbrücken at Sulzbach. He supplied his own illustrations of the furnace employed for this purpose, and it is interesting to know that this was in reality a gas-retort—probably the earliest one that was built on a practical, industrial scale, and closely akin to the present-day coke-recovery oven. The apparatus

included 'an internal sealed firebrick chamber', called by the author 'the retort'. But this furnace was used for coking only, and the fact that the more important commodity, gas, was formed at the same time was unnoticed by de Gensanne or any contemporary observer.

The latter half of the eighteenth century was marked by a great wave of chemical research, and the consequent discovery of many highly important substances and gases. Especially prominent among the discoveries to be attributed to this period were those of carbonic acid gas, the result of experiments by Dr. Joseph Black in 1754, and oxygen, of which the credit belongs to Dr. Priestley, though the year that saw the successful conclusion of his investigations, 1774, was the approximate date of the same discovery on independent lines by Scheele. Seven years later Henry Cavendish began his epoch-making experiments on the nature of hydrogen, proving that the sole product of its combustion was water. At about the same period Lavoisier's researches into aeriform substances yielded him the honour of being the first to make 'water' gas. He was also the inventor of the gasometer. In 1781 the results of experiments on the distillation of coal were issued to the public by the Rev. Dr. Watson, who afterwards became Bishop of Llandaff. But Dr. Watson's purpose was to discover the quantity of liquid, or tar, that was yielded by various substances in the process of distillation. Although he collected some of the resulting gas in bladders, and even burnt it, he did not realize the prospects which lay before his eyes. The same remark must apply to the tar-making activities of the ninth Earl of Dundonald, father of the famous admiral. He, too, entirely missed the significance of the gas which was one of his inevitable by-products.

It was reserved for a Scotsman to carry out the epoch-making discovery of coal-gas as an illuminant, and also to put it to the great purpose of serving the needs of the public. William Murdock, who was born in 1754 in the parish of Auchinleck, Ayrshire, came to Birmingham in 1777 and obtained employment from his fellow-countryman James Watt (q.v.), the inventor of the steam-engine, in the firm of Boulton & Watt. He was sent to Cornwall to take charge of the firm's pumping machinery for the tin-mines, and it was here that he conducted and perfected his experiments to such purpose that in the year 1792 he lit up his house in Redruth by means of gas. Later he erected a gas apparatus on a large scale in the firm's Soho foundry at Birmingham, which in 1802, on the occasion of the Peace of Amiens, was illuminated for the public benefit. At the same time a contemporary French inventor, Philippe Lebon, was experimenting with gas distilled from wood. In 1802

Lebon successfully lit his house in Paris by gas, and made plans to supply a large part of the city. In 1804, however, Lebon was murdered by an unknown assassin.

Both Lebon and Murdock aimed merely at a system of lighting for individual houses, and the application of gas to the general illumination of the community's streets and highways was reserved for an early admirer and follower of Lebon named Winsor. Winsor was a man of a totally different character from either Murdock or Lebon. He was of the company promoter rather than the inventor type. He came to London, and it was largely due to his enterprise that in 1812 a Royal Charter was granted to a company for the lighting of certain streets in Westminster. The resulting company, originally known as the Chartered Gas Company, was ultimately called the Gas Light and Coke Company. It has developed into a great organization, and is the largest, as well as the oldest, gas undertaking in the world.

By the middle of the century the position of gas as an illuminant was duly established in all the large towns in the kingdom. The gas-meter, invented in 1815 by Samuel Clegg and put into practical use ten years later, solved the initial difficulty of supply, and overcame the problem of checking the consumption of individual users.

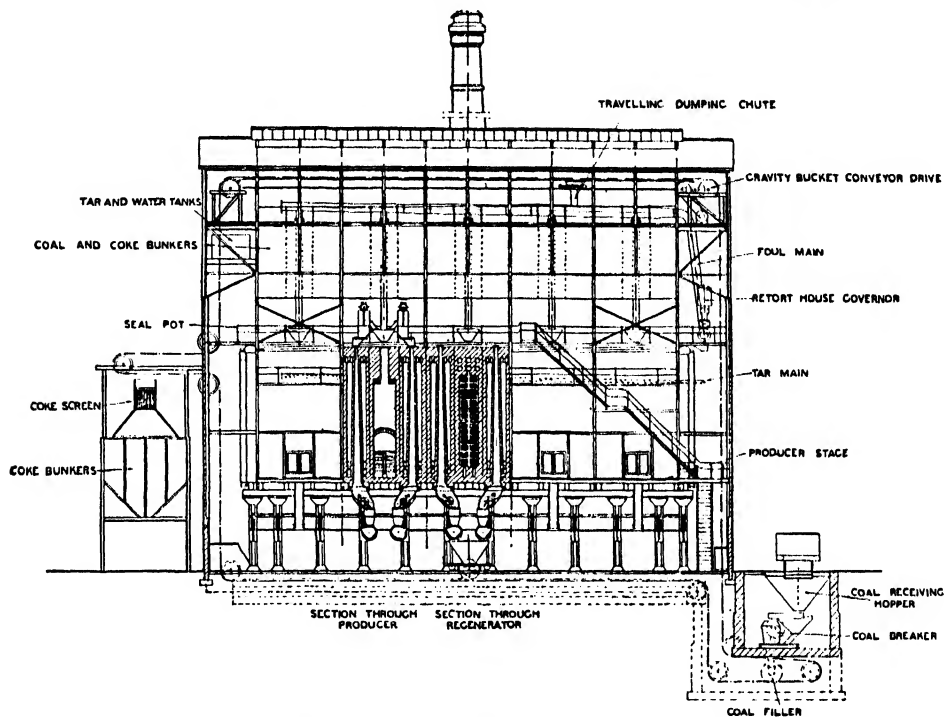
During its earlier years gas was regarded as an illuminant solely; it was not until the middle of last century that the first serious efforts were made to use it for heating purposes. During the last fifty years, however, both the popularity and the efficiency of gas as a heating agent have grown by leaps and bounds. Drawbacks have been gradually and continually eliminated, until the gas-fire of to-day from the point of view of hygiene, efficiency, and economy need fear no criticism. The gas-cooker has become no less popular, and for similar reasons. Domestically it has done much to help to solve the servant problem.

As far as illumination is concerned, a revolution in the whole theory and practice of gas-lighting has been brought about by the invention of the incandescent gas-mantle in 1885 by the Austrian von Welsbach.

Von Welsbach's system consists briefly in constructing a mantle of textile fabric, and saturating it in a solution of the rare metallic salts thorium nitrate (99 parts) and cerium nitrate (1 part). The fabric is then burnt away so as to leave the oxides of the metals as a skeleton, which can be raised to brilliant incandescence by the heat of burning gas. About 1900 an improved form of incandescent mantle, the inverted mantle, was introduced. For all practical purposes the old flat-flame type of burner may be considered entirely obsolete.

The introduction of the incandescent mantle was of particular importance, because it meant that the illuminating quality of gas was now a matter of minor importance. For the light given by the incandescent mantle is due entirely to the *heating* of the mantle. Thus the heating or calorific value of the gas had become the essential factor, not only, of course, for cooking and heating, but actually for lighting also. This was recognized by the passage of the Gas Regu-

the single-ended type, and 20 feet when open at both ends, although other sizes are sometimes used. They are fixed together in settings of two to ten, which are heated sometimes by one furnace and sometimes by two. In some of the larger works several sets of retorts are heated from one large furnace placed in a central position. In the largest gasworks they are built in benches which contain upwards of 150 'through retorts'. These retorts are charged almost full



Installation of Five Settings of Four 5-ton Vertical Retorts. Longitudinal Section (see next page)

By permission of the Woodall-Duckham Vertical Retort Company, Limited.

lation Act, 1920, which substituted a thermal or calorific standard for the illuminating power standard which had hitherto been insisted on.

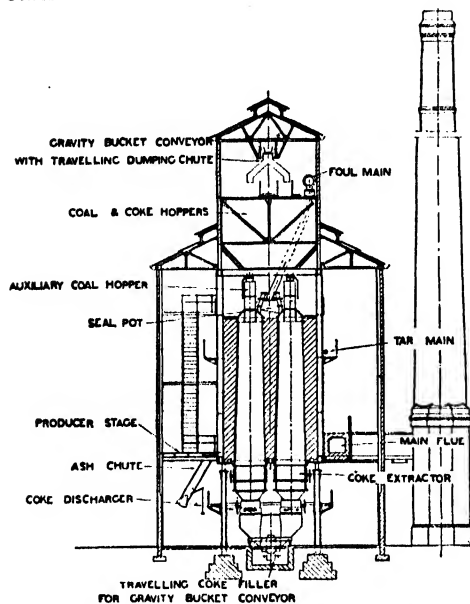
Gas Manufacture.—Gas manufacture in its present form is a highly complicated process, involving very different apparatus from the crude appliances that were designed by the original inventors and their immediate successors. It would be well to explain at the outset that the process of gas manufacture is known as 'destructive distillation' or 'carbonization'.

In a thoroughly up-to-date gasworks the crude coal is placed in fireclay retorts. These retorts have internal dimensions of 21 inches by 15 inches, and are generally 10 feet in length for

with coal, and are charged and discharged about twice every twenty-four hours.

Retorts are generally horizontal, but they are sometimes inclined at an angle of 30° or so, and in some of the most modern systems of carbonizing the retort is vertical. The latter two systems have the great advantage of allowing the coal to enter the retort by gravity, and the coke to leave the retort by the same agency, thereby becoming in a large measure automatic. Horizontal retorts are, however, the more widely used at the present time. They can be operated by machinery using either hydraulic, pneumatic, or electric power. This is specially the case where the retorts are open at both ends, 'through

retorts', as they are called, the coal being fed in at one end and the coke removed through the other end.



Cross-section of the Installation on previous page:

Now let us follow the gas on its way from the retort. The gaseous matter is in its early progress laden with aqueous and tarry vapours, which

retort up what is called the ascension-pipe, the gas passes through a hydraulic main (B in illustration) into a condenser (D). This consists of a number of vertical or horizontal pipes of considerable diameter, for the purpose of cooling the gas. The pipes are kept cool by the surrounding air, supplemented, if necessary, by water-sprays. In passing through the condenser the gas is slowly reduced to a lower temperature, and thus the aqueous vapour condenses into water, heavily charged with ammonia, and this water proceeds to absorb sulphuretted hydrogen and carbonic acid from the gas, the heavier tarry vapours condensing at the same time into tar. The ammoniacal liquor is at one point drained off into an underground tank, while the tar, which separates from the liquor by gravity, is drained off into another tank. The next stage is the passage through the exhaustor E (a pump for drawing off the gas from the retorts and so reducing the pressure on them), and then into the washer F, the object of which is to absorb the ammonia and partly further to condense what tarry vapours are still left in its composition. In the following stage the gas undergoes a scrubbing process, where the last traces of ammonia are extracted. From the scrubber (H) the gas passes into the purifier (I), where the greater part of the carbonic acid and the sulphur compounds are removed, and then finally it is conveyed by a pipe (K) into the gas-holder, whence it passes through the large gasworks meters and governors, and thence to the consumers through the street mains.

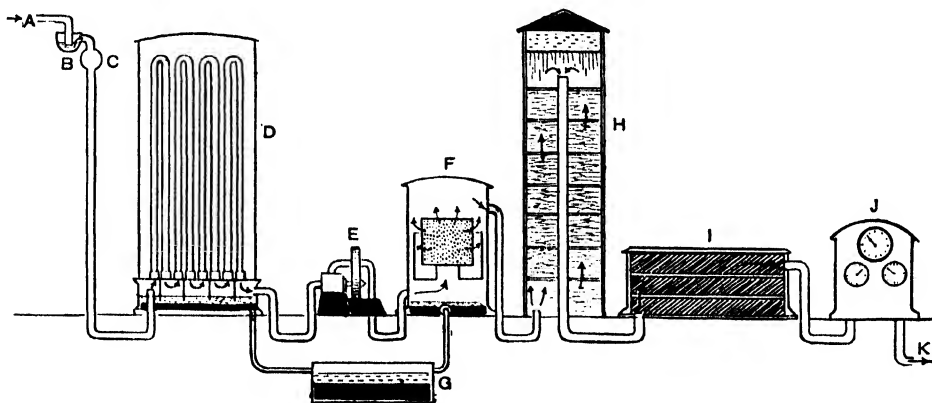


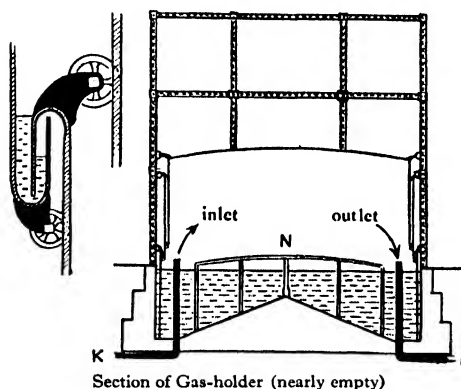
Diagram of a Gas-making Plant

A, From retorts. B, Hydraulic main. C, Foul main. D, Condenser. E, Exhaust pump. F, Washer. G, Tar well. H, Scrubber. I, Purifier. J, Meter. K, To gas-holder.

it is necessary to remove in order to purify the gas in the first place, and, in the second place, to recover the by-products. Passing from the

Of the by-products there is a very large number, and their value is very considerable. The most important of them is coke, which is the

solid residue of the distilled coal, and is a most valuable smokeless fuel both in industry and for domestic use. The second main by-product is tar, from the distillation of which an enormous number of subsidiary products, used for an enormous variety of different purposes, is produced. Dyes, acids, disinfectants, fuel oil for naval purposes, benzene, motor spirit, and high explosives (such as T.N.T.) are all produced from tar. A third by-product is ammoniacal liquor, which by the application of sulphuric acid produces the well-known and invaluable artificial manure and fertilizer sulphate of ammonia. Another by-product is cyanogen liquor, from which prussic acid is derived, as well as the valuable pigment known as Prussian blue.



N, Bridge to support dome. K, From meter. M, To consumer. On left is shown one of the grips that lift up telescopic divisions of gas-holder. Water forming a seal is picked up in grip from well.

When coal is burned in the raw state, whether in domestic fire or industrial furnace, all these valuable products are, of course, lost to mankind. Instead they are poured forth, imperfectly consumed, into the air in the shape of smoke and soot, which cut off the health-giving rays of the sun, and are thus of great detriment to the health of urban communities. Not only so, but the actual buildings of a city are destroyed by the acids and tarry matter of the smoke, and the expenses of city life are considerably increased (e.g. in excessive expenditure on laundry-work), while its amenities are correspondingly reduced. — **BIBLIOGRAPHY:** Walter Hole, *The Distribution of Gas*; Thomas Newbigging, *Handbook for Gas Engineers and Managers*; Charles Hunt, *A History of the Introduction of Gas Lighting*; W. H. Y. Webber, *Town Gas and Its Uses*; Gas, *Manufacture, Distribution, and Use*; *Notes for Lessons* (British Commercial Gas Association); L. G. Chiozza Money, *The Nation's Wealth*.

Gascolgne (-koin'), George, English poet, born 1535, educated at Cambridge, admitted to Gray's Inn in 1555. Being disinherited by his father, he served with distinction in Holland and was made prisoner by the Spaniards, but returned safely to England, and died at Stamford in 1577. He is chiefly remembered for his blank-verse satire *The Steele Glas* (1576), and the *Complaynt of Philomene*, a rhyming elegy (1576), but he wrote two or three comedies and tragedies. Gascoigne's complete poems were edited by W. C. Hazlitt in 1868 for the Roxburgh Library. A new edition appeared in the Cambridge English Classics.

Gascolgne, Sir William, an English judge of the Court of King's Bench, born about 1350, died in 1419. He is chiefly famous for directing the imprisonment of the Prince of Wales (afterwards Henry V), who had struck him in open court for condemning one of his dissolute friends. He also declined to obey the king and sentence Archbishop Scroop to death, alleging that the law gave him no power over the life of an ecclesiastic. In each case the king ultimately approved his action.

Gas'cony, an old division of France, between the Garonne, the sea, and the Pyrenees. The Gascons, who are of mixed Basque and Gothic descent, used to have the character of being brave, faithful, and tenacious of purpose, but much given to boasting, whence the word *gasconnade*.

Gas Engine. See *Internal-combustion Engines*.

Gases, Properties of. The characteristic features which distinguish a gas from a liquid or a solid have been stated under *Fluid*. The term *vapour* is used somewhat loosely to denote a gas under such conditions of temperature and pressure that it can be readily condensed into a liquid (see *Vaporization*). For every substance there is a certain temperature, called its *critical* temperature, above which the substance cannot exist as a liquid or a solid, no matter how great a pressure is applied to it. Certain gases used to be called the *permanent* gases, the chief being oxygen, air, carbon monoxide, nitrogen, and hydrogen. The critical temperature of these is so low that they were never found occurring except in the gaseous state. Now, however, with improved means of obtaining very low temperatures, these gases (and others discovered recently, such as argon and helium) have all been liquefied and many solidified (see *Liquefaction of Gases*). A *perfect* gas is an ideal substance with properties of a specially simple type. These properties are expressed in 'laws' which no actual gas obeys perfectly, but only more or less approximately, the approximation becoming closer the further removed the gas is from the liquid phase. These laws of gases are:

(1) *Boyle's (or Mariotte's) Law*.—The product of the pressure and volume of a gas is constant when the gas, its mass, and its temperature are given.

(2) *Charles's (or Gay-Lussac's) Law*.—Every gas expands for a rise of temperature of 1°C . by the same fraction of its volume at 0°C ., the pressure being constant. The fraction is $1/273$ nearly. If v_t is the volume at $t^{\circ}\text{C}$., the law gives $v_t = v_0(1 + t/273)$. If further we write T for $t + 273$, then T is the absolute temperature in degrees centigrade, and the equation becomes $v_t/T = v_0/273$; or, in words, the volume at constant pressure is proportional to the absolute temperature.

If p is the pressure, the laws (1) and (2) may be combined in the single statement $pV = RT$, R being a constant. When the mass of the gas is one gramme-molecule, i.e. a number of grammes equal to the molecular weight of the gas, then R has the same value for all gases.

(3) *Avogadro's Law*.—At given temperature and pressure, equal volumes of all gases contain the same number of molecules. At 0°C . and 76 cm. pressure (see *Hydrostatics*), 1 c.c. of any gas contains 2.7×10^{19} molecules. The *Avogadro constant* is the number of molecules in one gramme-molecule of any gas, or 6.06×10^{23} (see *Electron*).

(4) *Joule's Law*.—The internal energy of a given mass of a gas is a function of its temperature only.

The deviations from these laws shown by actual gases have been the subjects of a great deal of important experimental work. Amagat, working with pressures up to 300 atmospheres, showed that hydrogen is less compressible than if it obeyed Boyle's Law; nitrogen and carbon dioxide behave like hydrogen at high pressures and temperatures, but in the opposite sense (i.e. they are too compressible for Boyle's Law) at low pressures. The deviation of a gas from Joule's Law—the Thomson-Joule effect—has an important practical application in the liquefaction of gases (q.v.). For the application of the properties of gases to the measurement of temperature, see *Thermometry*. See also *Heat*; *Temperature*; *Thermodynamics*; *Diffusion*; *Solution*; *Ionization*.

Gas'kell, Elizabeth Cleghorn, novelist, daughter of William Stevenson, editor of *The Scots Magazine*, born at Chelsea in 1810, died at Alton, Hampshire, in 1865. She was brought up by an aunt at Knutsford in Cheshire (the original of the village in her story of *Cranford*), and married in 1832 the Rev. William Gaskell, a Unitarian minister at Manchester. Her first work of importance, *Mary Barton*, appeared in 1848, based upon the struggles then rife in Lancashire between workmen and employers. The *Moorland*

Cottage, a Christmas story, appeared in 1850; and in 1853 her next regular novel, *Ruth*, which aims a distinct blow at the common moral judgments of society. *Lizzie Leigh*, *Cranford*, and other minor tales appeared at various times in *Household Words*, in which also she wrote her next novel, *North and South*, a Yorkshire tale. In 1857 appeared her admirable *Life of Charlotte Brontë*, and in 1860 *Sylvia's Lovers*. *Wives and Daughters* appeared posthumously in 1866. An edition of her works (The Knutsford Edition) appeared in 1906.

Gaspé, a district of Canada, province of Quebec, on the south of the St. Lawrence estuary, washed by the Gulf of St. Lawrence, of which Gaspé Bay is an inlet. The fisheries are valuable; Gaspé Basin is a port on Gaspé Bay.

Gassen'di (properly *Gassend*), Pierre, French philosopher and mathematician, born in 1592, died in 1655. At nineteen he was appointed to the chair of philosophy at Aix. His *Exercitationes Paradoxicæ adversus Aristoteleos* (1624), while they gave great offence to the Aristotelians, obtained him a canonry in the cathedral of Digne; but a second book of *Exercitationes* excited so much enmity that he ceased all direct attacks on Aristotle, contenting himself with the exaltation of Epicurus. He strenuously maintained the atomic theory, in opposition to the views of the Cartesians, and, in particular, asserted the doctrine of a vacuum. He was appointed lecturer on mathematics in the Collège-Royal at Paris in 1645, but was compelled to return to Digne, where he lived from 1647 to 1653, in which interval he published his *De Vita, Moribus et Doctrina Epicuri* (1647), and *Syntagma philosophiæ Epicuri* (1649). In 1653 he went again to Paris, where he published the lives of Tycho Brahe, Copernicus, Peirese, and Regiomontanus (John Muller).—Cf. G. S. Brett, *Philosophy of Gassendi*.

Gastein, or Wildbad Gastein, a watering-place in Austria, 3000 feet above the sea, 48 miles south of Salzburg, with thermal springs (64° to 100°) containing salt and carbonates of magnesia and lime. It gives its name to a treaty, the Convention of Gastein, signed here on 14th of Aug., 1865, by the Emperor of Austria and the King of Prussia, the non-observance of which led to the German War of 1866.

Gaster, Moses, Roumanian philologist, Hebrew scholar, and folklorist, born at Bucharest in 1856. Educated in his native town, and at the universities of Leipzig and Breslau, he was for some time lecturer at the university of Bucharest, but was expelled from Roumania in 1885 for agitating on behalf of the persecuted Roumanian Jews. He proceeded to England, where he settled, and in 1886 was Ilchester lecturer at Oxford. In 1887 he was appointed Haham, or

Chief-Rabbi of the Portuguese (Sephardi) Jewish Communities in the United Kingdom. A man of a vast erudition, a linguist and a scholar, he wrote on Roumanian philology, Biblical questions and folk-lore. His works include: *Chrestomathie Roumanic*, *Sephardi Prayer Book*, *The Samaritan Book of Joshua*, *The Hebrew Divorce*, and *Roumanian Bird and Beast Stories*.

Gas'teropods (Gasteropoda), a class of mol-luscs, consisting of animals inhabiting a univalve shell, although some of the group are wholly destitute of a shell. The shell is either a small internal plate, as in slugs; or cone-shaped and spiral, as in the majority; or multivalve, the pieces following each other along the middle line, as in the chitons (coat-of-mail shells). The distinguishing characteristic is the foot, which is a broad, muscular expansion of the ventral surface. The class is divided into four sub-classes. (1) Amphineura: chitons, and some other primitive forms. (2) Prosobranchia: sea-snails with gills in front of the heart, as whelks, periwinkles, top-shells, cowries, &c. (3) Opisthobranchia: sea-snails and sea-slugs with gills—when present—behind the heart, as bubble-shells (Bulla), sea-hare (Aplysia), and the pelagic sea-butterflies (Pteropoda). (4) Pulmonata: land and fresh-water snails, and land-slugs, breathing by lung-like organs.

Gaston de Foix (fwà), Duke of Nemours, French soldier, born 1489, son of John de Foix, Comte d'Estampes, and Mary of Orleans, sister of Louis XII, whose favourite he became. At the age of twenty-three he routed a Swiss army, rapidly crossed four rivers, drove the Pope from Bologna, and won the celebrated battle of Ravenna (1512), but was killed while attempting to cut off a body of retreating Spaniards.

Gastor'nis, a large fossil bird, imperfectly known, remains of which have been discovered in the Lower Eocene deposits of Meudon, near Paris, and in the London Clay of England. The bones indicate a bird with poorly developed wings, as tall as the ostrich, and allied to the wading-birds.

Gastric Juice is the chief agent of digestion in the stomach, and is secreted by the cells in its wall. It is a clear, strongly acid, odourless fluid in its pure state, and contains hydrochloric acid, a ferment called pepsin, and small quantities of various salts in solution, chiefly chlorides and phosphates.

The chief digestive function of the gastric juice is due to pepsin, which acts on proteins, converting them into peptones, the first step in breaking down the complex proteins into simpler substances. It also curdles milk, converts cane-sugar into simpler bodies, and begins the process of splitting up the fats.

Pepsin can only act effectively in an acid

medium, hence the necessity of having hydrochloric acid present for efficient digestion. The presence of the hydrochloric acid further causes the gastric juice to be antiseptic, and thus leads to the destruction of many of the organisms swallowed with the food, and prevents putrefactive changes taking place in the stomach. Disease may cause a diminution, or even complete absence, of one or other of the ingredients of the gastric juice, and thus lead to serious disturbances of digestion and metabolism, with resulting malnutrition and emaciation.

Gastrolo'bium, a large genus of leguminous plants occurring in South-Western Australia. Several of the species often prove fatal to cattle which eat of their foliage, and they are hence known as poison-plants.

Gastromy'cetes, the highest class of Basidiomycetous Fungi, distinguished by the possession of elaborate and often curiously formed fruit-bodies, which remain closed until quite ripe; it includes, among other types, the puff-balls (Lycoperdon, Scleroderma), earth-stars (Geaster), bird's-nest fungi (Nidulariaceæ), and stinkhorns (Ithyphallus, Clathrus).

Gastros'teus, the genus comprising the fresh-water three-spined and two-spined sticklebacks (*G. aculeatus* and *G. pungitius*).

Gastrostomy is the operation for the formation of a permanent artificial opening into the stomach through which the patient can be fed. It is performed in cases of malignant disease, or intractable obstruction, of the gullet when the patient is exposed to the risk of starvation from his inability to take nourishment.

Gastrotomy is the operation of opening the stomach. It is performed for the removal of foreign bodies, for exploratory purposes, or as a means of dilating strictures at either of the orifices of the stomach.

Gas'trula, in embryology, that stage in the development of multicellular animals in which the embryo has the form of a two-layered sac enclosing a central cavity which communicates with the outside by means of an opening called a *blastopore*. The gastrula stage follows the *blastula* stage, which is either a hollow sphere (*blastosphere*) or a solid mass of cells (*morula*), smaller at one pole. It is developed from the blastosphere by a process of invagination, or infolding of the *hypoblast*, the inner layer of the cavity referred to, into the inside of the *epiblast* or outer layer. In the case of a morula the small cells increase and grow over the larger ones, a central cavity being formed by separation of the inner cells. The cavity, in either case known as an *archenteron*, is a primitive digestive cavity, and the blastopore is a primitive mouth.

Gates, Horatio, an American officer during the Revolutionary War, born in England in 1728,

died in 1806. He rose to the rank of major by merit alone. At the capture of Martinique he was aide-de-camp to General Monkton, and he was with Braddock when the latter was defeated in 1755. On the conclusion of peace he purchased an estate in Virginia, on which he resided until the Revolutionary War in 1775, when he was appointed adjutant-general by Congress, with the rank of brigadier. At the head of the American army of the north he compelled the British general, Burgoyne, to surrender his whole army at Saratoga (1777). In 1780, after the capture of General Lincoln, Gates received the chief command of the southern districts, but was defeated two months later by Cornwallis at Camden. He was then superseded by General Greene and tried by court-martial, but was finally acquitted, and reinstated in his command in 1782 after the capture of Cornwallis. He then retired to Virginia, and in 1790, having emancipated all his slaves, he removed to New York, where he died.

Gateshead, a municipal, county, and parliamentary borough, England, county Durham, on the right bank of the Tyne, opposite Newcastle, of which it is practically part, being connected with it by three bridges. Its industries are much the same as those of Newcastle, including large engineering and ironworks, the making of glass and chemicals, and shipbuilding. In the vicinity are quarries from which the celebrated 'Newcastle grindstones' are obtained, and numerous collieries. The town sends one member to the House of Commons. Pop. 124,514.

Gath (Heb., 'wine-press'), one of the five royal cities of the Philistines, which, from its situation on the borders of Judah, was of much importance in the wars of the Jews and Philistines. It was the native town of Goliath, and was captured successively by David, Hazeal, and Uzziah, who dismantled it. The site cannot be determined with certainty, but it is sometimes identified with Tell-es-Sâfieh, between Ekron and Ashdod.

Gatineau (gat-i-nō'), a river of Canada, Quebec Province, the largest affluent of the Ottawa, rising in some lakes, and flowing almost due south to enter the Ottawa nearly opposite Ottawa City. It is not navigable more than 5 miles above Ottawa except by canoes, but its rapid waters are well stocked with fish, and available as water-power.

Gatling-gun, one of the original forms of machine-gun, i.e. a mechanical fire-arm controlled by one man, and capable of firing a great number of rounds in a given space of time.

The Gatling-gun was invented in the United States about 1862, and proved itself much superior to the earlier mitrailleuse which had been evolved by the French, and used in the Franco-German War. The Gatling had ten

barrels fixed round an axis, and this axis was constructed to revolve by the simple method of turning a handle. The sheaf of barrels was connected by various arrangements of carriers and locks, with a drum or cartridge-container placed over the breech end of the barrels, and the action of the mechanism—controlled by the handle—caused the barrels, carrier, and locks to revolve, and the cartridges to be forced into the barrels, fired, and afterwards extracted. The rate of fire was limited by the speed at which the handle could be turned and by the capacity of the drum, which, when empty, had to be replaced by hand; 1000 rounds a minute has been reached with this weapon. The whole gun was mounted on a wheeled carriage. The Gatling-gun was at one time in use in the British army, but has now been superseded by more modern weapons.

Gat'shi-na, or **Gatchina**, a town, Russia, government of and 35 miles s.s.w. of Petrograd, on a small lake. It is regularly built, and contains one of the finest of the palaces of the former Emperors of Russia. Pop. 14,700.

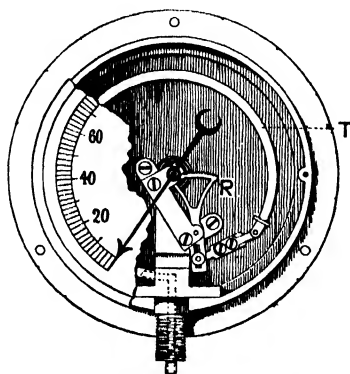
Gau (gou), a German word of doubtful origin, meaning in general district, but in a special sense a district as a political unit, and its inhabitants as a political association. It formed a sort of middle division between the highest unit, the state, and the lowest, the village, corresponding in some respects to the 'hundred'. The freemen of the Gau met at certain periods, under an elected head, to settle matters relating to the public weal; and in the same way the head men of the Gauen met to settle matters relating to the state at large. In the Frankish Empire the character of the Gau was altered, each Gau there having as its head one or more royal officers called *Grafs* or *Counts*. These countships became hereditary, and about the twelfth century the Gau ceased to exist as a political division, though the name has survived, e.g. in Aargau and Thurgau.

Gauchos (gà'ü-chōs), natives of the pampas of the La Plata countries in South America, of Spanish descent with only slight Indian admixture. The race is noted for its spirit of wild independence, for horsemanship, and the use of the lasso. Their mode of life is rude and uncivilized, and they depend for subsistence chiefly on cattle-rearing. The Gauchos, it seems, do not eat salt.

Gauge, a standard of measurement. As applied to railways, gauge is the distance between the two lines of rails forming the way; the ordinary or British gauge being 4 feet 8½ inches. The 'broad gauge' of the Great Western Railway of England was 7 feet. The Irish gauge is 5 feet 3 inches, the Indian and Spanish gauge 5 feet 6 inches. Narrow gauges have often been

adopted for cheapness, e.g. a 3-feet-6-inch gauge. A 'break of gauge', where lines of different gauge meet, is a great hindrance to traffic. Gauge is also the name applied to contrivances for measuring any special dimensions, such as the wire-gauge, an oblong plate of steel, with notches of different widths cut on the edge and numbered, the size of the wire being determined by trying it in the different notches until one is found which it exactly fits.

Gauge, Steam, an instrument for indicating the pressure of the steam in a boiler or other



Bourdon Steam-pressure Gauge

T, Metal composition tube of elliptical section one end of which is soldered into a boss by which the pressure is admitted to the interior of the tube, while the other end is closed by a cap. When pressure is admitted to the tube the elliptical section has a tendency to change to the circular form. Consequently the tube tends to straighten, and the free end of the tube moves outward. This movement is multiplied and communicated to the pointer by a toothed quadrant gearing R. By permission of Messrs. The Budenberg Gauge Co., Ltd.

vessel. The Bourdon instrument consists of a flat, spirally-coiled metal tube with a sealed end. When the pressure inside this tube exceeds the pressure outside, it tends to uncoil slightly, and to rotate a pointer on the front of the instrument. The amount of rotation depends on the pressure inside the coiled tube. If the pressure inside is less than that outside, the rotation is in the opposite sense, so the instrument can be used as a *vacuum gauge*.—BIBLIOGRAPHY: W. Inchley, *Steam Boilers and Accessories*; *Modern Mechanical Engineering* (The Gresham Publishing Company).

Gauge, Water, or Gauge Glass, is a gauge for indicating the level of the water in a boiler. It consists of a glass tube which is attached by a brass or gun-metal fitting at each end to the boiler. One end of the glass tube communicates with the steam-space, and the other end with the water-space of the boiler, so that the water in the glass tube is at the same level as the water in the boiler. Also, in physics, any U gauge in

which water is used, so that the difference of pressure registered is that due to the measured 'head' of water.

Gauguin, Paul, French painter, born 1848, died 1903, was originally in the merchant service and then in a financial house, and did not entirely devote himself to art until 1883. For a time he worked under Impressionist influences until he went to Martinique, and then in 1889 to Brittany, where he became the chief figure of the Pont-Aven group, and developed a highly individual and characteristic art. In 1891 he went to Tahiti, where, except for a short return to France, he spent the rest of his life, living and working among the natives. He justified this course on the ground that only the primitive and uncivilized could sufficiently stir his imagination. His work is marked by a bold simplification of natural forms, decorative design, and the use of brilliant, arbitrary colour. He is represented by two small pictures in the Tate Gallery.

Gaul, or **Gallia**, in ancient geography, the country of the Gauls, the chief branch of the great original stock of Celts. It extended at one time from the Pyrenees to the Rhine, and included also a part of Italy. Hence it was divided into Gaul on this side (the Roman side) of the Alps, or Gallia Cisalpina, and Gaul beyond the Alps, or Gallia Transalpina. Eventually the former was regarded quite as part of Italy, and the name Gallia was restricted to Transalpine Gaul, or the country nearly corresponding to modern France. Julius Caesar, about the middle of the first century B.C., found Transalpine Gaul divided into three parts: (1) Aquitania, extending from the Pyrenees to the Garonne, chiefly occupied by Iberian tribes; (2) Gallia Celtica, Celtic Gaul, from the Garonne to the Seine and Marne; (3) Gallia Belgica, Belgic Gaul, in the north, extending to the Rhine.

Migrations among the Gauls about 397 B.C., and their passage of the Alps, first bring the Gallic nation into the region of history. Having crossed the Alps, they fell upon the Etruscans, defeated the Romans at Allia (390 B.C.), and sacked and burned Rome, the Capitol, however, being saved by Camillus. More than a century after the burning of Rome, the Eastern Gauls, between 280 and 278 B.C., made three destructive irruptions into Macedonia and Greece. Several tribes pursued their course into Asia Minor, where, under the name of *Galatians*, they long retained their national peculiarities. After these migrations the Gauls along the banks of the Danube and in the south of Germany disappear. Tribes of German origin occupy the whole country as far as the Rhine, and even beyond that river. The Belgæ, who were partly German, occupied the northern part of Gaul, from the Seine and Marne to the English Channel and the

Rhine, from whence colonists passed over into Britain, and settled on the coast districts. The Celts in Gaul had attained some degree of cultivation by intercourse with the Greeks and Carthaginians before they came in contact with the Romans. Those of Cisalpine Gaul continued formidable to Rome until after the first Punic War, when the nation was compelled, after a war of six years duration, to submit to the Romans (220 B.C.). When Hannibal marched on Rome, they attempted to shake off the yoke; but the Romans, victorious over the Carthaginians, again reduced them to submission. Thirty-one years later (189 B.C.) their kindred tribe in Asia, the Galatians, met with the same fate; they also were vanquished, and their princes (tetrarchs) became tributary. Between 128 and 122 B.C. the Romans conquered the southern part of Gaul along the sea from the Alps to the Pyrenees, and here established their dominion in what was called the Province (Provincia), a name that still exists as Provence. Not long after, Gaulish tribes shared in the destructive incursions of the Cimbri and Teutones on the Roman territory, which were ended by Marius in the battles of Aquæ Sextiæ (Aix) in 102, and Verceil in 101 B.C. On the appointment of Julius Cæsar to the proconsulship over the countries bordering on Gaul, he resolved to subject all Gaul, and executed his purpose, in less than nine years (58-50 B.C.), in eight bloody campaigns. The dominion of the Romans in Gaul was confirmed by colonies, and the liberal grant of the Roman citizenship to several Gallic tribes. The religion of the Druids, being suppressed in Gaul by Tiberius and Claudius, gradually retreated into Britain, soon also conquered by the Romans. After the extinction of the Cæsars, the Gauls once more attempted to recover their liberty by aid of the Germans, but after this last effort became entirely Romanized, even their ancient language, the Celtic, being supplanted by a corrupt Latin dialect. About the year 486 the Franks subdued the greater part of Gaul, and put a period to the dominion of the Romans in that country. See *France*.—BIBLIOGRAPHY: Martin de Syr, *La France avant César*; Fustel de Coulanges, *Histoire des institutions politiques de l'ancienne France*.

Gault, in geology, a series of stiff, but sometimes calcareous, clays, varying in colour from a light grey to a dark blue, occurring between the Upper and Lower Greensands of the Cretaceous system of England. The gault is well developed at Folkestone, and forms a band of clay-land, with good brickworks, at the foot of the North and South Downs.

Gauntlet, or **Gantlet** (O.Fr. *gantlet*, dim. of *gant*, glove), a glove made originally of chain-mail, later of plate, and jointed at the fingers,

used as part of the armour of a warrior in former times. The gauntlet was introduced in the thirteenth century. The throwing down of the gauntlet was an accepted method of challenging to combat.

Gaur, or **Gour**, a ruined city in Hindustan, 60 miles north by west of Murshedabad. From 1212 to 1574 it was the capital of Bengal, extending about 7 miles along the old Ganges. Its decay proceeded from the change in the course of the river, about two centuries since. The principal ruins are a magnificent mosque, faced with black porphyry, two gates, a large edifice faced with bricks of various colours, and a lofty obelisk or tower. Several villages now stand on the site of the city.

Gaur, or **Gour**, one of the largest of all the ox tribe (*Bos gaurus*), ranging through India, Burma, and the Malay Peninsula, remarkable for the extraordinary elevation of its spinal ridge, the absence of a dewlap, and its white 'stockings', which reach above the knee. It is so fierce when roused that neither tiger, rhinoceros, nor elephant dare attack it. The hide on the shoulders and hind-quarters is sometimes nearly 2 inches in thickness even after being dried, and is therefore much valued for the purpose of being made into shields. The animal is not domesticated to any great extent.

Gauss (gous), Karl Friedrich, a German mathematician, born 1777, died in 1855. In 1801 he published his *Disquisitiones Arithmeticae*, treating of indeterminate analysis or transcendental arithmetic, and containing, in addition to many new theorems, a demonstration of the theorem of Fermat concerning triangular numbers. He also calculated, by a new method, the orbit of the planets Ceres and Pallas. In 1807 he became professor of mathematics and director of the observatory at Göttingen, a position which he held till his death. He was pronounced by Laplace to be the greatest mathematician in Europe. His chief works were the *Theoria Motus Corporum Cælestium* (1809), *Intensitas Vis Magnetica Terrestris* (1833), *Dioptrische Untersuchungen* (1841), and *Untersuchungen über Gegenstände der höheren Geodesie* (1844).

Gautier (gō-ti-ä), Judith, French poet and novelist, born at Paris 1850, died in 1917. A daughter of Théophile Gautier and Carlotta Grisi, the famous Italian singer, she married first Catulle Mendès, from whom she soon separated, and afterwards Pierre Loti. A distinguished Oriental scholar, her works deal mostly with Chinese and Japanese subjects. *The Book of the Jade*, her first work, appeared in 1867 under the name of Judith Walther. It was followed in 1869 by *The Imperial Dragon*, a Chinese romance, signed Judith Mendès. *The Usurper*, a Japanese romance,

appeared in 1875, and was crowned by the Academy. Her other works include: *Lucienne* (1877), *The Cruelties of Love* (1878), *Poliphar's Wife* (1884), and *The Merchant of Smiles* (1888).

Gautier, Théophile, French poet and critic, born 1811 at Tarbes (Hautes-Pyrénées), died in 1872. He studied painting under Rioult for two years, but gave up the brush for the pen, threw himself vigorously into the Romanticist movement, published a volume of poems in 1830, and for several years worked at general literary criticism. In 1832 appeared his poem *Albertus*; but his first great success was the romance *Mademoiselle de Maupin*, which led to his engagement by Balzac as secretary. He was afterwards engaged as theatrical and art critic on the *Revue de Paris*, the *Artiste*, the *Moniteur*, and the *Journal Officiel*. Owing to his connection with the *Journal Officiel* his fortunes became linked in some measure with those of the Bonaparte family, and he was appointed librarian to the Princess Mathilde. In 1872 he was sent by the Republican Government on a literary mission to Italy, and died in the same year. Among the most interesting of his productions may be ranked his *Voyages en Espagne* (1843), his *Italia* (1852), *Caprices et Zigzags* (1845), and *Constantinople* (1854), narratives of his travels; his *Roman de la Momie* (1856), *Le Capitaine Fracasse* (1863), *Belle Jenny* (1865), *Spirite* (1866), novels, together with the brilliant short stories, *Fortunio*, *Une Nuit de Cléopâtre*, *Jean et Jeannette*, and *Le Roi Candaule*; and his *Histoire de l'art dramatique en France depuis vingt-cinq ans* (1849), and *Les Beaux Arts en Europe* (1852).—Cf. F. Brunetière, *Évolution de la poésie lyrique*.

Gavar'ni, the assumed name of *Hippolyte Guillaume Sulpice Chevalier*, French caricaturist, born at Paris in 1801, died in 1866. Originally a mechanical draughtsman, he began his artistic career in 1835 by designing costumes for theatres and journals of fashion. He then established *Les Gens du Monde*; but the journal was a failure, and the artist spent some time in the debtor's prison of Clichy. On his release he was employed upon the *Charivari*, the success of which was due in great part to his genius. In 1848 he visited England, and the sketches which he sent from St. Giles, London, to *L'Illustration* created an immense sensation. His best-known works are: *Les Enfants Terribles*, *Les Rêves*, *Les Fourberies de Femmes*, and *Impressions de Ménage*. He afterwards illustrated Eugène Sue's *Wandering Jew*, Balzac's novels, and other works.—Cf. E. and J. de Goncourt, *Gavarni, l'homme et l'œuvre*.

Gavazzi (gà-vât'sè), Alessandro, popular Italian preacher and religious reformer, born at Bologna 1809, died at Rome 1889. At the age of fifteen he became a monk of the Barna-

bite order, at twenty he was professor of rhetoric in the College of Naples, and soon after made his mark as a pulpit orator. In 1846 he was chaplain-general of the Roman Patriotic League. Subsequently he threw off his Papal allegiance and joined the agitation which ended in the short-lived republic. The French occupation of Rome drove him into exile, when he travelled through Britain and America lecturing against the Church of Rome, his power as an orator evoking much enthusiasm. He was with Garibaldi in 1860, and made subsequent visits to Britain gathering funds for the Free Italian Church, in the interests of which he lectured, preached, and travelled on deputation work till his death.

Gavelkind (from *gabhail*, tenure, and *cine*, family), an old English tenure, by which the land of the father was, in the event of his intestacy at his death, equally divided among his sons, or in default of sons, among the daughters. The issue of a deceased son inherited the father's part. Collaterally, also, when one brother died without issue all the other brothers inherited from him. Gavelkind, before the Norman Conquest, was the general custom of the realm; it was then superseded by the feudal law of primogeniture, and only retained in Wales and Kent. The custom continued in Wales till the time of Henry VIII; in Kent all land is still held in gavelkind unless specially disgavelled by Act of Parliament.

Ga'vial, or Gharial (*Gavialis gangeticus*), the Indian crocodile, characterized by the narrow almost cylindrical jaws which form an exceedingly elongated muzzle. The teeth (about 120 in number) are of equal length, and the feet are completely webbed. The males can be distinguished from the females by the shape of the muzzle, which is much smaller at the extremity. The only extant species occurs in South and Eastern Asia, especially in the Ganges, and attains a length of 20 feet. It feeds solely on fishes.

Cavotte', an air for a dance with two strains, each of four or eight bars, in $\frac{2}{4}$ or $\frac{1}{2}$ time, the starting notes occupying half a bar. Like the minuet, it has been introduced for free treatment into suites and sonatas. The name is said to be derived from the Gavots, the inhabitants of the Pays-de-Gap, in Dauphiné.

Gawain (W. *Gwalchmei*), one of the Knights of the Round Table, a nephew of King Arthur, and son of Loth, King of Norway and the Orkneys. Gawain tried in vain to pull the magic sword from the magic stone, and failed in his quest of the Holy Grail. He has been identified by some writers with the Irish hero Cuchullin (q.v.).—Cf. J. L. Weston, *The Legend of Sir Gawain*.

Gay, John, English poet, born near Barnstaple in 1688, died in 1732. He was apprenticed to a silk mercer in London, but in 1712 became secretary to Anne, Duchess of Monmouth. In 1713 he published his *Rural Sports*, which he dedicated to Pope, with whom he formed a close friendship. In 1714 his caricature of Ambrose Philips's pastoral poetry was published, under the title of *The Shepherd's Week*, and dedicated to Lord Bolingbroke, by whose interest he was appointed secretary to the Earl of Clarendon, in his embassy to the court of Hanover. His mock-heroic poem, *Trivia, or the Art of Walking the Streets of London*, appeared in 1715, and in that year also was acted his burlesque drama of *What d'ye Call It?* but his next piece, the farce *Three Hours after Marriage*, altogether failed. In 1720 he published his poems by subscription, in 1724 his tragedy *The Captives*, and in 1727 his well-known *Fables*. His *Beggar's Opera*, the idea of which seems to have been originated by Swift, was first acted in 1728 at Lincoln's Inn Fields, where it ran for sixty-three nights, but the Lord Chamberlain refused to license for performance a second part entitled *Polly*. *The Beggar's Opera* was successfully revived at the Lyric Theatre, Hammersmith, in 1920. Gay also wrote the pastoral *Acis and Galatea* and the opera *Achilles*. The closing years of his life were mostly spent in the house of the Duke of Queensberry.—BIBLIOGRAPHY: Dr. Johnson, *Lives of the Poets*; Thackeray, *English Humorists*; Lewis Melville, *Life and Letters of John Gay*.

Gay, Marie-Françoise-Sophie, French authoress, born at Paris 1776, died at Paris in 1852. Her maiden name was Nichault de la Valette, and she was first married to a financier, M. Liottier, from whom after six years she was divorced to marry M. Gay, a Receiver-General under the Empire. Her salon was a famous resort for the men of letters and artists of the time. Her chief works are: *Laure d'Estell* (1802), *Léonie de Montbreuse* (1813), *Anatole* (1815), *Scènes de jeunes âges* (1833), *La Duchesse de Châteauroux* (1834), *Les Salons célèbres* (1837), and *Le Mari confident* (1840). For her daughter, Delphine Gay, see *Girardin (Madame de)*.

Gayá, the chief town of a district of the same name in Bengal, on the right bank of the Phalgu, a tributary of the Ganges, 260 miles N.W. of Calcutta. It consists of an old and a new town. The former occupies a rocky height, is inhabited chiefly by Brahmans, and, being regarded as a place of great sanctity, is annually visited by vast crowds of pilgrims. The latter, called Sahibganj, is the trading-quarter, and the seat of administration, where the European residents dwell. The place abounds with objects of Hindu worship, and almost every height in the vicinity

is the subject of a legend. Pop. 40,921. The district has an area of 4712 sq. miles, and a pop. of 2,225,000.

Gayal', or Gyal, a species of ox (*Bos frontalis*) native to the mountains of Northern Burma and Assam, and long domesticated in these countries and in the eastern parts of Bengal. Its occurrence in the wild state is doubtful. The head is very broad and flat in the upper part, and contracts suddenly towards the nose; the horns are short and slightly curved. The animal has no proper hump, but on the shoulders and fore-part of the back there is a sharp ridge. The colour is chiefly a dark brown. Its milk is exceedingly rich, though not abundant.

Gay-Lussac (gā-lūs-āk), Louis Joseph, French chemist and physicist, born at St. Léonard (Haute-Vienne) 1778, died at Paris 1850. He was educated in the École Polytechnique from 1797 to 1800, and afterwards in the École des Ponts et Chaussées, but preferring chemistry, he entered Berthollet's École Laboratoire at Arcueil. In 1802 he returned to the Polytechnique as demonstrator of chemistry, and in 1804 performed his two balloon ascents for scientific purposes, the first with Biot, the second by himself, an account of which appeared in the *Journal de Physique*. In 1806 he was elected to the Academy of Sciences. In 1808 he was appointed to the professorship of physics at the Sorbonne, a post he held for twenty-four years; in 1809 he was made professor of chemistry in the École Polytechnique, and then succeeded Fourcroy as professor of general chemistry in the Jardin des Plantes. In 1831 he entered the Chamber of Deputies, and in 1839 he was made a peer of France, but he never took an active part in politics. He was especially celebrated for his researches into the chemical and physical properties of gases and vapours. For many years he edited, in conjunction with Arago, the *Annales de chimie et de physique*; and many of his numerous memoirs were published in this or in the *Comptes Rendus*. He also published, along with Thénard, *Recherches physico-chimiques*, in which some of their most important discoveries are described. Other works are his *Cours de physique* and *Leçons de chimie*.

Gaza, Theodore, Renaissance scholar, born at Thessalonica about 1400, died in Calabria in 1475 or 1478. He came to Italy about 1430; became teacher of Greek at Ferrara; and was patronized by Pope Nicholas V, Cardinal Bessarion, and King Alfonso of Naples. Gaza laboured for the diffusion of Greek literature, not only by teaching, but also by his writings, and especially by Latin translations of the Greek classics. His chief work is a translation of the writings of Aristotle on natural history.

Gaza, an ancient town of Palestine, the

modern Ghazze, originally a city of the Philistines, near the Mediterranean, 50 miles s.s.w. of Jerusalem. It is one of the most important ports of Palestine, manufactures pottery, is a centre of trade, and exports barley. The town was taken by Napoleon in 1799. During the European War the battles of Gaza were fought between the Turks and the British in March and in April, 1917. The town was captured by the British under Allenby in Nov., 1917. Pop. about 15,000.

Gazelle' (*Gazella dorcas*), the type of a sub-family of antelopes (Gazellinæ), which includes some twenty-five species of small, mostly desert-loving forms. Its colour is a light fawn upon the



Gazelles (*Gazella dorcas*)

back, deepening into dark-brown in a wide band which edges the flanks and forms a line of demarcation between the colour of the upper portions of the body and the pure white of the abdomen. The eye of the gazelle is large, soft, and lustrous. Both sexes are provided with horns, round, black, and lyrate, about 13 inches long. It seems to be confined to the north side of the Atlas Mountains, Egypt, Abyssinia, Syria, Arabia, and South Persia.

Gazette' (from *gazzetta*, a small Venetian coin, which was the price of the first newspaper), a newspaper, especially an official newspaper. The first gazette in England was published at Oxford in 1665. On the removal of the court to London the title of *London Gazette* was adopted. It is now the official newspaper, and published on Tuesdays and Fridays. It is the organ by means of which all State intelligence, proclamations, and appointments are promulgated, and in which declarations of insolvency are published. A similar official newspaper is published also in Edinburgh and Dublin. See *Newspaper*.

Gazetteer', a geographical dictionary; a book containing descriptions of natural and political divisions, countries, cities, towns, rivers, and mountains alphabetically arranged. Among the more important general works of this kind are: M'Culloch's *Geographical Dictionary*, Longmans' *Gazetteer of the World*, Blackie's *Imperial Gazetteer*, Lippincott's *Pronouncing Gazetteer* (based upon Blackie's), Chambers's *Gazetteer of the World*, Vivien de Saint-Martin's *Nouveau dictionnaire de géographie universelle*, and Ritter's *Geographisch-Statistisches Lexikon*. There are also various gazetteers confined to particular countries.

Gean (gēn), a kind of wild cherry tree (*Prunus Avium*), common in Britain. The name 'gean' is mainly confined to Scotland and the north of England. The fruit is smaller than that of the common cherry, of a red colour when unripe, and a deep purple or black when it arrives at maturity. The flavour is superior to that of most cherries. The wood is used for furniture and other purposes.

Gearing, in engineering, sets of toothed wheels working together. The object of gearing is to transform a rotational motion at one speed into a similar motion at another speed. From the 'Principle of Work' it follows that the turning moments (or torques) on each wheel are altered in the inverse ratio to the speeds of the wheels. The simplest set of gearing consists of two toothed wheels working on parallel axes, the teeth being parallel to the axes. To reduce noise and friction as much as possible, it is important to shape the teeth so that as one tooth meshes into and leaves its mate, the teeth roll upon each other and do not slide relative to each other, i.e. the teeth must have a 'rolling' contact. When rolling contact exists, clearly no wasteful work is done against friction. The teeth can be shaped so as to have rolling contact. Two profiles are permissible, an involute profile or a cycloidal profile. The teeth are called involute and cycloidal teeth respectively. The

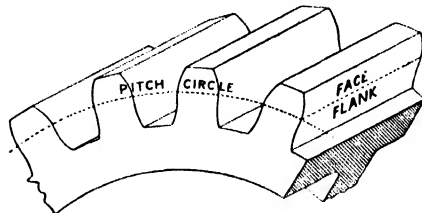


Fig. 1.—Names of Parts of Wheel Tooth

gear-wheels are replaced for purposes of calculation by two circles which roll on each other without slipping. These circles are called *pitch circles*. The ratio of the speeds of rotation is clearly inversely proportional to the ratio of

the diameters of the pitch circles. This ratio is called the *gear ratio*. The names given to some of the parts of teeth are shown in the figure

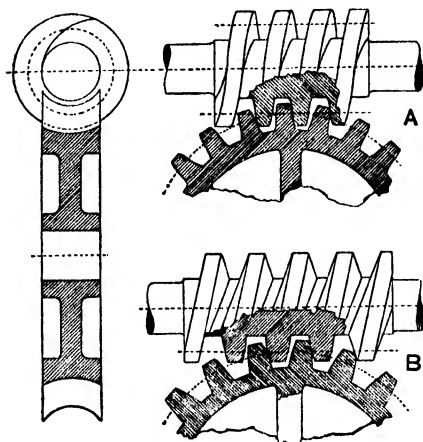


Fig. 2.—Worm Gear

A, Cycloidal teeth. B, Involute teeth.

on p. 233. The *circumferential pitch* of the teeth is the distance from a point on one tooth to the corresponding point on the next, measured along the circumference of the pitch circle. This

above root = $0.4p$; width = $2p$ to $3p$, sometimes in mill gears $5p$, where p is the circumferential pitch.

When two simple gears work in series so that the motion a is transformed by one gear into a motion b , and the motion b is transformed by a second gear into a motion c , the compound train is called a *double-reduction gear*. Similarly, we can have *treble-reduction* gears, and so on.

When the two axes are at right angles, the teeth lie on a conical surface, and the ends of the teeth are roughly at 45° to the plane of the wheels. Such trains are called *bevel-wheels*.

Sometimes a much higher gear ratio is required than can be conveniently provided with bevel-wheels. A *worm gear* is then employed, which is illustrated in fig. 2. Where great strength, high peripheral speeds, and freedom from vibration are required, *helical gears* are used for transforming motion between parallel axes. In helical gears the teeth are not parallel to the axis, but wind round the cylinder on which they are formed in the shape of a spiral or helix (see figure below). The cutting of such gears is a very difficult mechanical operation, and the process was perfected by Sir Charles Parsons about 1910. The perfecting of the methods for making these gears was a very great step in high-power mechanical engineering. The special points of these gears are: (1) a very

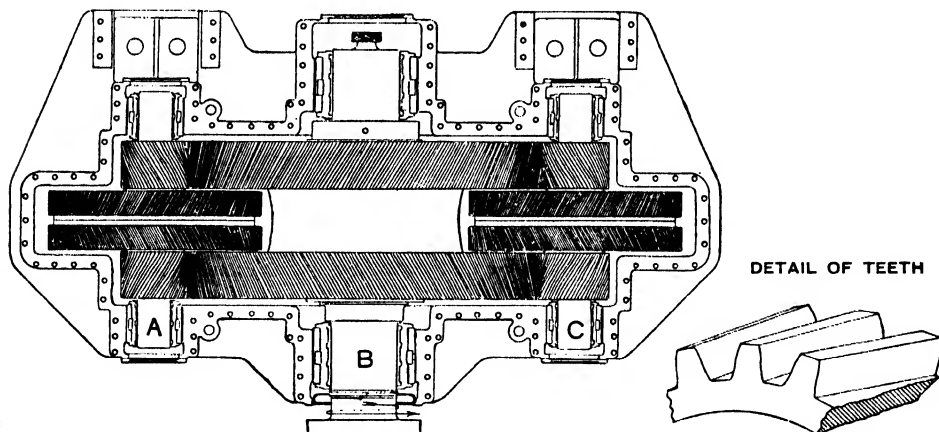


Fig. 3.—Parsons' Turbines for a Single-screw Cargo Boat: plan view of double reduction helical gearing

A, C, Turbine shafts (425 revolutions per minute). B, Propeller shaft (80 revolutions per minute).

measurement is also called the *circular pitch*. The *diametral pitch* is the diameter of the pitch circle divided by the number of teeth. The ordinary proportions for cast-iron teeth are as follows: thickness at the pitch circle = $0.47p$; height of tooth = $0.7p$; height of pitch circle

small pinion-wheel can be used with a large gear-wheel. The pinion-wheel need not be of very much larger diameter than the shaft fitting it. In this way very large gear ratios can be used—as much as 20 to 1. (2) The whole gearing can be run in oil, which is specially water-cooled.

(3) Two pinions can be fitted on to the driving-shaft, each of which gears into a corresponding gear-wheel. The helical teeth on these two wheels are arranged to point in opposite senses, so that the axial reaction of the one exactly balances that of the other. (4) From the combination of these points a very high rotational speed of the pinion can be associated with a comparatively low rotational speed of the gear-wheel, and at the same time a powerful torque can be transmitted by the pinion owing to the oblique setting of the teeth.

It is not too much to say that the invention of this gearing has revolutionized naval engineering. The great difficulty in employing the turbine in naval work was this: to be efficient, the turbine must be run at a very high speed, and a propeller at a moderate speed. Consequently, so long as a transformation of speeds was inadmissible, the turbine could only be used in naval engineering by sacrificing either turbine or propeller efficiency. With the introduction of single-reduction gearing with gear ratios up to about 20 to 1, both the turbine and the propeller shafts can be run at economical speeds.

Gearing, Differential, any mechanism which depends for its action on *differences* in the motions

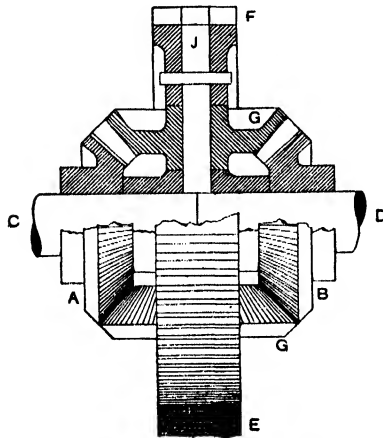


Fig. 4.—Differential Gear

of its component parts. A familiar example occurs in the motor-car. In going round a curve, one of the back wheels must move at a different speed from the other, if slipping is to be avoided. The back axle cannot therefore be made in one piece with a worm gear in the middle to drive it. It is made in two parts, coupled by an epicyclic train of wheels, the *differential gear*. One design is shown in fig. 4. The wheel EF, carrying the so-called *idle wheels* G, is driven direct by the engine. When the car is going along a straight

road, the idle wheels do not rotate about the spindles J, but, of course, revolve with the wheel EF which holds them. They therefore drive the bevel wheels A and B, and these rotate the car wheels. But if A is fixed, the idle wheels rotate about the spindles J, and also with the frame F. In rotating they drive B. A relative motion between A and B is thus made possible. Differential gearing is also used with governors, and in valve gears. See *Valves and Valve Gear*.—BIBLIOGRAPHY: D. A. Low, *Applied Mechanics*; *Modern Mechanical Engineering* (The Gresham Publishing Company); R. J. Walker, *The Application of Geared Turbines to Merchant Ships* (North-East Coast Institute of Engineers and Shipbuilders).

Gebang Palm, the *Corypha gebanga*, a fan-leaved palm of South-Eastern Asia. Its pith furnishes a sort of sago; its leaves are used for thatch, and made into hats, baskets, and bags; the fibres of its leaf-stalks are made into ropes, nets, and cloth, and the root is highly medicinal.

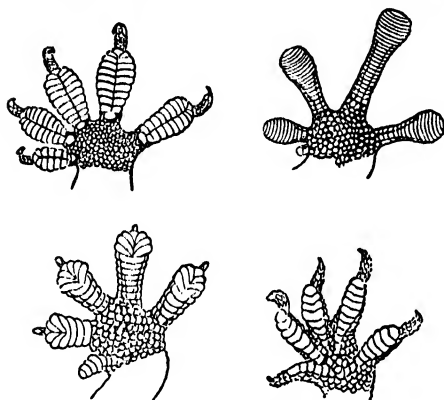
Geber (gē'bér), Arabian chemist or alchemist, often designated the father of chemistry, flourished during the eighth century. He was acquainted with nearly all the chemical processes in use down to the eighteenth century. Roger Bacon called him *Magister Magistrorum*. His writings describe various kinds of furnaces and other apparatus, and cupellation, distillation, and other chemical processes; the purification, composition, and properties of the metals then known—gold, silver, copper, lead, tin, and iron—and the functions of mercury, sulphur, and arsenic. He is the reputed author of an immense number of works on metaphysics, language, and astronomy, as well as on chemistry.

Gebweiler (geb-vi'ler), a town of France, in Alsace, on the Lauch. It has two fine Roman Catholic churches, and works for cotton-spinning and weaving, woollen manufactures, bleaching, dyeing, calico-printing, and machinery. Pop. 13,380.

Gecko, a name common to the members of a cosmopolitan family of nocturnal lizards (*Geckotidæ*), characterized by the general flatness of their form, especially of the head, which is somewhat of a triangular shape; the body is covered on the upper part with numerous round prominences or warts; the feet are rather short, and the toes of nearly equal length and furnished with flattened sucking-pads by means of which the animals can run up a perpendicular wall, or even across a ceiling. The greater number feed on insects and their larvæ and pupæ. Several of the species infest houses, where, although they are perfectly innocuous, their appearance makes them unwelcome tenants. One species (*Tarentola mauritanica*) is common in Northern Africa and Southern Europe. (See over.)

Ged (ged), William, inventor of stereotyping, born in Edinburgh about the beginning of the eighteenth century, died in poor circumstances in 1740. He first practised his great improvement in the art of printing in 1725; and some years later he entered into a partnership in London, the result of which was the production of two prayer-books only. He returned to Scotland in 1733, and published a stereotype edition of Sallust in 1744.

Geddes (ged'es), Alexander, a Roman Catholic priest, poet, and miscellaneous writer, was born in the county of Banff, Scotland, in 1737, died in London 1802. At the age of twenty-one he was sent to the Scottish college at Paris, and, returning to Scotland in 1760, he took charge



Under sides of Feet of Various Geckos

of a Roman Catholic congregation at Auchinhalrig, in Banffshire, where he became known for his scholarship. In 1779 the University of Aberdeen granted him the degree of LL.D., and the next year he repaired to London with a view to obtaining facilities for his scheme of a new English translation of the Old and New Testaments. Two volumes of his translation and a volume of critical remarks were published, but the rationalistic views promulgated met with much censure, and his own immediate superiors suspended him. He was in the midst of a translation of the *Psalms* when he died. His other works include numerous pamphlets, translations, and macaronic poems.—Cf. T. K. Cheyne, *Founders of Old Testament Criticism*.

Geddes, Sir Auckland Campbell, British politician, born in 1879. Educated at Edinburgh, he became a doctor, and was in succession assistant professor of anatomy at Edinburgh, and professor at the McGill University, Montreal, and at the Royal College of Surgeons, Dublin. During the European War he first served at the front, where he rose to the rank of brigadier-

general. In 1916 he was appointed Director of Recruiting, and in Aug., 1917, became Minister of National Service. President of the Local Government Board in 1918, and Minister of Reconstruction in Jan., 1919, he was appointed President of the Board of Trade in May of the same year. In March, 1920, he was sent as British Ambassador to the United States. He was knighted (K.C.B.) in 1917, and was made a Privy Councillor in the same year.

Geddes, Sir Eric Campbell, British politician, born 26th Sep., 1875, in India. Educated at Edinburgh, he entered the service of a railway company in America, but returned to Britain, where he became deputy manager of the North Eastern Railway Company. In 1915 he entered the Ministry of Munitions, and was sent to France as director of military railways. Controller of the Navy in 1917, he became First Lord of the Admiralty, and in 1919 first Minister of Transport, resigning in 1921. He was knighted in 1916, made a Privy Councillor, a K.C.B. (military), and a Knight Grand Cross of the Order of the British Empire in 1917, and in 1919 he was promoted to be a G.C.B. (civil).

Geddes, Jenny, the name tradition gives to a street fruit-seller who, during the tumult in St. Giles Church, Edinburgh, on Sunday, 23rd July, 1637, when the dean attempted to introduce the Episcopalian service-book, threw her stool at his head exclaiming, "Villain! dost thou say mass at my lug?" This tumult led to events which annulled Episcopacy and restored Presbyterianism. The honour of the exploit has been claimed for a Barbara Hamilton, wife of John Mein, merchant in Edinburgh, but Jenny Geddes the street fruit-seller's claim has always been the popular one, and a memorial brass has been placed in St. Giles to her memory.

Geefs (gäfs), Guillaume, Belgian sculptor, born at Antwerp 1806, died 1883. Among his most important works are the monuments to the victims of the Revolution of 1830 at Brussels; a statue of Rubens in front of Antwerp Cathedral; and statues of King Leopold. His brothers Joseph (died 1860) and Aloys (died 1841) were also sculptors of reputation, the latter also producing some historical paintings.

Geelong (jē-long'), an Australian seaport town, colony of Victoria, near the head of the west arm of Port Philip Bay, 45 miles southwest of Melbourne. The town is well laid out on ground sloping to the bay, and its streets abound with fine shops, business premises, and public buildings. There is an extensive and well-laid-out botanical garden and several public parks belonging to the town. There are three jetties in the bay, alongside of which ships of the largest tonnage can load and discharge. There are wool-mills, tanneries, and ropeworks, and a

considerable trade is done in wool. The country surrounding Geelong is essentially agricultural, and is taken up by farms and orchards. Pop. 30,652.

Geestemünde (gās'tè-mùn-dé), a seaport town of North Prussia, in Hanover, at the mouth of the Weser, separated from Bremerhaven by the Geeste. Extensive docks were constructed here between 1857 and 1863. The port is strongly fortified, and the trade is considerable. The industries include shipbuilding, iron-founding, and engineering. Since 1889 Geestemünde has included the adjoining Geestendorf; total pop. 20,340.

Gefle (yef'le), a seaport, Sweden, near the mouth of a river of the same name in the Gulf of Bothnia, 50 miles N. of Upsala. It stands on both sides of the river and two islands formed by it, and has an excellent harbour. It has manufactures of linen, leather, tobacco, and sail-cloth; shipbuilding yards; and an extensive trade in deals, tar, pitch, and iron. Pop. 36,623.

Gegenbaur (gä'gen-bour), Karl, German comparative anatomist, and advocate of the evolution theory, was born in 1826 at Würzburg, and died in 1903. He studied medicine, and became assistant physician in the Julius Hospital in his native town. In 1852 he gave up this post to undertake zoological researches in the Mediterranean, and in 1855 went to Jena as professor. While there he abandoned zoology and devoted himself entirely to comparative anatomy. He was transferred in 1873 to Heidelberg, and retired in 1901, dying two years later. In 1859 (the same year in which Darwin published his *Origin of Species*) Gegenbaur published an important work on comparative anatomy on evolutionary lines, which was followed by other works of a like kind, besides *Erlebtes und Erstrebtes* (1901), an autobiographical sketch.

Gehen'na, a term used in the New Testament as equivalent to a place of fire or torment, and rendered in the Authorized (and the Revised) Version by *hell* and *hell-fire*. It is a form of the Hebrew *Ge-hinnom*, the valley of Hinnom, in which was Tophet, where the Israelites sometimes sacrificed their children to Moloch (2 Kings, xxiii, 10). On this account the place was afterwards regarded as a place of abomination, and became the receptacle for the refuse of the city, perpetual fires being kept up in order to prevent pestilential effluvia.

Geibel (gi'bl), Emanuel, German poet, born at Lübeck 1815, died 1884. He studied at the Universities of Bonn and Berlin, and resided a year or two in Greece. He published his first collection of poems in 1840, which reached its hundredth edition in 1884. In 1843 he published a tragedy, *King Roderick*; in 1846 the epic *König Sigurd's Brautfahrt*. Collections of his poems appeared in 1848, 1857, and 1864. From

1851 to 1869 he was professor of æsthetics and poetry at Munich. He wrote also *Brunhild*, a tragedy; *The Loreley*, an opera; and other plays; but his fame rests on his lyrics, which were immensely popular.

Geiger, Abraham, Jewish theologian and scholar, one of the foremost advocates and initiators of religious reform in Germany, born at Frankfort-on-the-Main in 1810, died in 1874. He studied at the Universities of Heidelberg and Bonn, became Rabbi at Wiesbaden, and subsequently at Breslau, Frankfort, and Berlin. From 1862 till his death he edited the *Jüdische Zeitschrift*, and stood for the reform of Judaism and liberality in the observance of the traditional law. His works include: *Urschrift und Uebersetzungen der Bibel*, *Sadducæer und Pharisæer*, *Das Judentum und seine Geschichte*, and *Salomon Gabirol und seine Dichtungen*.

Geijer, Erik Gustaf, Swedish historian, born at Ransäter, Värmland, 12th Jan., 1783, died 23rd April, 1847. Educated at the University of Upsala, he began to lecture there in 1810, and in 1817 became professor of history. He was also a poet and a musician, and during the last ten years of his life he took an active part in politics. He exercised a considerable influence upon the historical literature of his native country. Among his works are: *Seea Rikes Håfder* (Records of Sweden), in which he intended to relate the history of Sweden from mythical ages to the present time, but of which he only finished the introductory volume (1825); *Svenska Folkets Historia* (History of Sweden down to the death of Queen Christina), (1832-6). His collected works, with a biographical sketch, were published by his son (1873-7).

Geikie (gē'ki), Sir Archibald, K.C.B., O.M., geologist, born at Edinburgh 1835. Appointed to the geological survey, he became director of the Scottish branch in 1867; was professor of geology at Edinburgh from 1871 to 1882; director-general of the United Kingdom survey and head of the Museum of Practical Geology, London, from 1882 to 1901. He was awarded the Order of Merit in 1914. He is the author of *Text-book of Geology*, *Class-book of Geology*, *Field Geology*, *The Scenery of Scotland in connection with its Physical Geology*, *Ancient Volcanoes of Britain*, *Life of Sir R. I. Murchison*, *Memoir of Sir A. C. Ramsay*, *Scottish Reminiscences*, *Love of Nature among the Romans*, *The Birds of Shakespeare*, and *Annals of the Royal Society Club*. He died in 1924.

Geikie, James, geologist, brother of Sir Archibald Geikie, born at Edinburgh 1839, died in 1915. He was engaged on the Scottish survey from 1861 until he succeeded his brother in the geological professorship at Edinburgh in 1882. He was the author of *The Great Ice Age*; *Prehistoric Europe*; *Outlines of Geology*; *Mountains*:

their Origin, Growth, and Decay; and The Antiquity of Man in Europe.

Geisha, a term applied to a class of Japanese women, endowed with personal attractions and accomplished in the arts of music and dancing. They entertain guests at social parties, dinners, and receptions, and customers in tea-houses. The meaning of the word is 'one with pleasing accomplishments'. The geishas are not only clever singers and dancers, but also amusing conversationalists. They are trained from the age of seven, and they correspond to the almehs of Egypt.

Geissler Tubes, vacuum tubes first made by Geissler of Bonn. They are made of glass, and contain a highly rarefied gas at a pressure of less than $\frac{1}{2}$ mm. of mercury. When an electrical discharge is passed through a tube from an induction coil, it is accompanied by beautiful luminous effects, the colours of which depend on the nature of the gas. The tubes are useful for the spectroscopic examination of the luminous gas. See *Ionization*.

Gela (jē'la), one of the most important ancient Greek cities of Sicily, situated on the south coast of the island between Agrigentum and Camarina; founded in 690 B.C. by a colony of Cretans and Rhodians. The colony was remarkably prosperous, and in 582 B.C. sent out a portion of its inhabitants, who founded Agrigentum. In 280 Phintius, the tyrant of Agrigentum, utterly destroyed Gela. Its site has been the subject of much controversy.

Gelada (gel'a-da), a singular Abyssinian baboon, remarkable for the heavy mane which hangs over the shoulders, and which only grows when the animal is adult.

Gelasius (je-), the name of two Popes—*Gelasius I* and *II*. The former, who held the see from 492 to 496, founding on the alleged primacy of Peter, was one of the first who openly maintained that the Roman bishop alone was entitled to regulate matters of faith and discipline, though in practice he had not then attained any such superiority. *Gelasius II*, Pope for only one year (1118-9), and originally called John of Gaeta, was elected by the party hostile to Henry V, but was obliged to give way to Gregory VIII, supported by the emperor, and shortly after died in the monastery of Clugny.

Gelatine is a nitrogenous substance derived from the cartilage and skins of young animals, and differs only from glue (q.v.) and size in the care with which the raw material is selected and treated. The purest form of gelatine is prepared from the head and leg portions of calves, which are useless for leather purposes. The raw material must be perfectly fresh, and all decomposition avoided during subsequent manufacture. It is first carefully cleaned from traces

of blood and flesh by washing, and then treated with steam or boiling water. The solution of gelatine thus obtained is allowed to settle, and decolorized by treatment with sulphurous acid. After filtration, the hot solution is poured into moulds and allowed to set to a firm jelly, which is cut into slices and dried on nets; this imparts the cross-markings always seen on sheet gelatine. The drying process must be very carefully watched, as the moist gelatine readily undergoes decomposition. Gelatine is also produced in the form of threads and as powder. It is largely used in cookery for the preparation of soups and jellies, and in confectionery for making pastilles and jujubes. The gelatine capsules used in medicine are made from a more flexible mixture of gelatine and glycerine. Very large quantities are used in photography for the coating of films and plates; the introduction of gelatine for this purpose, in place of albumen and collodion, has revolutionized photography. It is essential that the gelatine should be absolutely pure, since the smallest amount of putrefaction would cause the formation of substances which would destroy the silver salts present in the film.

Chemically, gelatine is a substance closely related to, but not identical with, the proteins. It contains the elements carbon, hydrogen, nitrogen, oxygen, and sulphur. When pure, it forms a colourless, transparent, and flexible substance which is absolutely tasteless and odourless. Gelatine is insoluble in alcohol or ether, but caustic soda and potash dissolve it readily, even in cold weak solutions. It swells in cold and dissolves readily in hot water. A 1 per cent solution should set to a jelly on cooling. Gelatine, heated too often or too long, loses this property of setting, which is the main source of its value. A solution of gelatine gives with tannic acid a flocculent precipitate which is insoluble in water; this reaction is practically identical with that which takes place during the tanning of hides for the manufacture of leather. Both as a jelly and in solution, gelatine gives a slight Tyndall effect, reflecting a beam of light sideways; but the ultramicroscope does not show definite particles. Gelatine is rendered absolutely insoluble in water by treatment with formaldehyde. In this form it is used, when dyed, for making spangles for dresses and for other purposes. Isinglass (q.v.) is a very pure form of gelatine derived from the swim-bladder of the sturgeon.

Within recent years the importance of the chemistry of colloids (q.v.) for many industries and manufactures has become generally recognized, and much important research work in this field has been carried out by chemists. The colloid which has been most fully investigated is gelatine.

Gelderland, Guelderland (gel'), or **Guel-ders**, a province of the Netherlands; area, 1939 English sq. miles. It is generally flat, and has much alluvial soil, well fitted both for arable and grass husbandry. The manufactures, principally woollen, cotton, and linen goods, soap, salt, and glass, are carried on extensively in various quarters. The principal towns are Arnheim, Nijmegen, Thiel, and Zutphen. Pop. (1918) 727,165.

Geldern (gel'dérn), a town of Rhenish Prussia, 27 miles north-west of Düsseldorf. Pop. 6420.

Gélée (zhé-lā), Claude. See *Claude Lorraine*.

Gellert (gel'ért), Christian Furchtegott, German poet, born 1715, died 1769. He was appointed extraordinary professor of philosophy at Leipzig in 1751, where his lectures were received with great applause. His hymns, tales, fables, and essays enjoyed much popularity in their day.

Gellius, Aulus, a Roman author of the second century. His *Noctes Attice*, a sort of commonplace book, is now of great value, as many of the works from which he drew his materials are lost.

Gellivara (gel-i-vä'rä), a mountain and town in Northern Sweden, within the Arctic Circle, in a locality exceedingly rich in iron ore. The town is connected by railway with Luleå, on the Gulf of Bothnia, and with the growing Norwegian port of Narvik on the Ofoten Fiord, in Norway, where quays and other works have been constructed for the shipment of the ore. Pop. 12,000.

Gelnhausen (gel'n'hau-zn), an old walled town of Prussia, province of Hesse-Nassau, 16 miles E.N.E. of Hanau, on the Kinzig. Its principal buildings are a large Gothic church of the thirteenth century, and, on an island in the Kinzig, a palace in which Frederick Barbarossa and several of his successors used to reside. Pop. 4859.

Gelon (gē'lon), an ancient Greek ruler, tyrant of Gela, and afterwards of Syracuse. After the death of Hippocrates, tyrant of Gela, he seized the sovereign power (491 B.C.), and about 485 B.C. gained possession of Syracuse. From this time he bent all his energies to the aggrandizement of his new capital, the power and importance of which he greatly increased by his conquests and good government. His aid was sought by the Greeks against Xerxes, but a formidable invasion of Carthaginians under Hamilcar engaged him in Sicily. The result was the total defeat of the Carthaginians in the great battle of Himera (480 B.C.). It is celebrated in an ode by Pindar. Gelon died in 478 B.C., and was succeeded by his brother Hieron.

Gelsemium (It. *gelsomino*, jasmine), a genus of plants belonging to the nat. ord. Loganiaceæ, the best known, *G. sempervirens* or Carolina jas-

mine, being an evergreen climbing shrub of the Southern States of America, with twigs producing a milky juice, opposite lance-shaped shining leaves, and sweet-scented yellow flowers. The root has valuable medicinal properties, being used for controlling certain forms of nervous irritability.

Gelsenkirchen (gel'zn-kirh-en), a town in Prussia, province of Westphalia, on the border of the Rhine Province, a few miles north-east of Essen and north-west of Bochum. It owes its rapid rise (from 844 inhabitants in 1852) to the development of the coal and iron industries, which it shares with neighbouring towns. The extension of its limits in 1903 greatly increased the population, which was 168,557 in 1919.

Gemara (ge-mä'ra), in Jewish literature, the second part of the *Talmud* or commentary on the *Mishna*. See *Talmud*.

Gemini (gem'i-ni), the Twins (II), the third sign of the Zodiac. The constellation Gemini was supposed to represent Castor and Pollux, the twins of ancient mythology. The two brightest stars of the constellation are named Castor and Pollux. Castor, which is a double star, is of 1½ magnitude, Pollux just a little under normal first magnitude. The sun is in the sign Gemini from about 21st May till 21st June, but is now in the constellation Gemini during a period about one month later.

Gemmation, in zoology, a mode of reproduction among certain animals of low type, which consists in the production of a bud or buds, generally from the exterior, but sometimes from the interior, of the body of the animal, which buds are developed into independent beings that may or may not remain attached to the parent organism. This mode of reproduction is typical of hydroid zoophytes, polyzoa, and some ascidians.

Gems, or precious stones, are sometimes found crystallized in regular shapes and with a natural polish, more commonly of irregular shapes and with a rough coat. The term gem often denotes more particularly a stone that is cut, polished, or engraved, and it also includes pearls and various artificial productions. The first and most valuable class of gems includes diamonds, emeralds, rubies, sapphires, and a few others; the second class includes the amethyst, topaz, garnet, &c.; while agate, lapis-lazuli, cornelian, &c., though much used for ornament, can scarcely be called gems. The various precious stones are described under their proper heads. The fabrication of artificial gems is now prosecuted with skill and capital, and has become an important industrial art. The base of one class of imitations is a peculiar kind of glass of considerable hardness, brilliancy, and refractive power called *paste* or *strass*, which consists of a complex borosilicate

of lead and potassium, and is distinguished from ordinary glass by the presence of 50 per cent of oxide of lead. When the strass is obtained very pure, it is melted and mixed with substances having a metallic base, generally oxides, which communicate to the mass the most varied colours. Another class, called semi-stones or doublets, are made by affixing thin slices of real gem to an under part of strass by means of an invisible cement. In some cases an imitation is made by setting uncoloured strass or quartz in jewellery with some coloured 'foil' at the back of it. Attempts have within recent years been made with a fair measure of success to manufacture true gems by artificial processes. The French chemists Becquerel, Ebelman, Gaudin, Despretz, and others have done much in this direction. In 1858 MM. Deville and Caron communicated to the Academy of Sciences, Paris, a process for the production of a number of gems of the corundum class, as rubies, sapphires, &c. The process essentially consisted in exposing the fluoride of aluminium, together with a little charcoal and boracic acid, in a plumbago crucible protected from the action of the air, to a white heat for about an hour. Many experiments with a view to producing diamonds artificially have also been made. From hydrocarbons, subjected to a very intense heat and enormous pressure, minute crystals, differing from natural diamonds in no respect save brilliancy and size, have been produced. In this way Henri Moissan has prepared artificial diamonds by dissolving carbon (sugar charcoal) in molten iron, and Parsons has done much work in the same direction. In art and archaeology the term gem is usually applied to a precious stone cut or engraved in ornamental designs, or with inscriptions. Stones on which the design is raised above the general surface are called *cameos*; those having the design sunk below the surface are called *intaglios*. Early specimens of cut gems are seen in the scarabæi or beetle-shaped signets worn in rings by the ancient Egyptians. Among the Greeks, Etruscans, and Romans gem-sculpture held a high place, reaching its highest point under Augustus. Modern gem-engraving dates from the beginning of the fifteenth century, the chief seats of the art being Italy and Germany. Rome is now the head-quarters of the seal-engraving art. The tools of the engraver consist of a lathe, and a series of little rods with heads of different shapes, all of which can be adjusted to the lathe. The axis of the lathe is pierced at the centre with an orifice, into which the tools for cutting the stone are firmly fixed by means of a screw. The engraver wets the extremity of the mounted rod with diamond-dust made into a paste with olive-oil, and as the wheel is in motion he applies the stone, firmly cemented to a piece of reed,

to the revolving tool. The diamond-dust enables the tool to cut into the stone with ease. As the design is frequently very elaborate and of the greatest delicacy, the tools are necessarily multi-form. The stones used for cameo-cutting often exhibit layers of different colours, so that the raised design has a tint distinct from the ground. Intaglios are very often executed in transparent stones, and the subjects treated in this manner are more limited in number. They are chiefly such as seals, devices, and coats of arms.—BIBLIOGRAPHY: C. W. King, *Antique Gems*; J. H. Middleton, *The Engraved Gems of Classical Times*; L. Claremont, *The Gem Cutter's Craft*; G. F. Kunz, *Curious Lore of Precious Stones*.

Gemsbok (gemz'bok), the *Oryx gazella*, a large powerful member of the antelope family, inhabiting the plains of South Africa. It equals the domestic ass in size, has a short erect mane, a long sweeping black tail, and long sharp-pointed heavy horns, nearly straight from base to tip, and obscurely ringed throughout the lower half. By the aid of these natural bayonets it can easily defend itself from the smaller Carnivora, and it has been known to drive off, and even kill, the lion himself.

Gendarmes (zhàn'därm), the name originally given in France to the whole body of armed men, but after the introduction of standing armies, to a body of heavy-armed cavalry, which composed the chief strength of the forces. Gendarmes are now the French armed police. They are all picked men; they are usually taken from the regular forces, and are of tried courage or approved conduct. There are *horse gendarmes* and *foot gendarmes*. They are formed into small units called *brigades*; and the union of a number of these forms a *departmental company*.

Gender (Fr. *genre*, Lat. *genus*), in grammar, one of those classes or categories into which words are divided according to the sex, natural or metaphorical, of the beings or things they denote. It may be exhibited by a class of words marked by similarity in termination, the termination having attached to it a distinction in sex, as seen in nouns, adjectives, and participles. There are three genders in all: *masculine*, *feminine*, and *neuter*, but these three distinctions only exist in some languages. In Sanskrit, Greek, and Latin all three are present, as also in German and English. English words expressing males are said to be of the *masculine* gender; those expressing females, of the *feminine* gender; and words expressing things having no sex are of the *neuter*, or *neither* gender. Gender is thus coincident with sex in English, and is a very simple matter. But in other languages sex and gender have little or no necessary relation, the majority of the names applied to inanimate objects being either masculine or feminine, and

the grounds for such distinction being quite obscure. In the languages derived from the Latin—Italian, French, Spanish, and Portuguese—a neuter gender is not recognized. In the highly inflected languages there are certain terminations distinctive of the different genders, but in English gender only to a slight extent depends on the form of the word—*ess*, for instance, is a feminine termination. In English the gender of a noun only affects the pronoun substituted for it.

Genealogy, the systematical investigation and exhibition of the origin, descent, and relations of families (or their *pedigree*). Persons descended from a common father constitute a family. Under the idea of *degree* of relationship is denoted the nearness or remoteness of relationship in which one person stands with respect to another. A series of several persons, descended from a common progenitor, is called a *line*. A line is either *direct* or *collateral*. The collateral lines comprehend the several lines which unite in a common progenitor. For illustrating descent and relationship genealogical tables are constructed, the order of which depends on the end in view. The common form of genealogical tables places the common stock at the head, and shows the degree of each descendant by lines. Some tables, however, have been constructed in the form of a tree, in which the progenitor (Ger. *Stammvater*) is placed beneath, as if for a root.—Cf. W. Rye, *Records and Record Searching*.

General, the military officer in whom is vested the command of a considerable body or formation of troops. Generically the two words 'general officer' are more properly used. In the British service there are three grades of general officer, the word general without prefix signifying the highest of these grades. Next below comes lieutenant-general, which again is followed by major-general. In conversation, and in all ordinary matters, the single word general is used for all three grades, while in formal official matters the full title is given. The title of brigadier-general formerly in use in the service has, since 1st Jan., 1921, been abolished. This was merely a temporary rank given to officers holding certain appointments, such, for instance, as brigade commander. On relinquishing such appointment the officer reverted to his substantive or permanent rank. Officers holding such appointments are now known as colonels-commandant or colonels on the staff. The badges of rank by which the various grades of general officers are distinguished are as follows: general, crossed sword and baton with star and crown; lieutenant-general, crossed sword and baton with crown only; major-general, crossed sword and baton with star only; while a colonel-

commandant wears three stars and a crown, the two lower stars being side by side. All these are worn on the shoulder-straps.

General Lien, in law, the right to retain possession of a chattel until payment be made, not only of any debt due in respect of that particular chattel, but of any balance that may be due on general account in the same line of business. General liens do not exist at common law, but depend entirely upon contract express or implied from the special usage of dealing between the parties.

General Ship, in maritime law, a ship which is announced by the owners to take goods from a particular port at a specified time, and which is not under special contract to particular individuals.

General Staff. Speaking generally, the staff consists of specially-trained officers who are appointed to assist commanders in carrying out their duties. A staff-officer as such has no military command, though in his rôle of confidential trained assistant he has considerable responsibility in working out details, sifting information, issuing the commander's considered orders, affording help to the troops when required, and attending to matters of routine.

The staff is divided into three main branches, the general staff, the adjutant-general's and the quartermaster-general's branches. The Staff Colleges at Camberley and Quetta are institutions where regimental officers are trained for war generally, and for service in all branches of the staff. The normal period of this course is two years, and, after each tour of service in a staff appointment, it is usual for an officer under the rank of substantive lieutenant-colonel to return to his unit for a further period of regimental service.

The general staff branch is charged with all matters affecting military operations and military training, such, for instance, as war organization, selection of lines of operation, plans for concentration of troops, information, and secret service. It is also the duty of this branch to appreciate the course of action in the event of war, and arrange it in accordance with the capabilities of the forces likely to be available. It also prepares in advance a plan of campaign.

The general staff, as the senior branch, and as being directly concerned with the collection of information, is responsible for the dissemination of any necessary information to the adjutant-general's and quartermaster-general's branches in sufficient time and in the necessary detail to enable these branches to carry on their work. Co-operation between the three branches is essential, and in general the chief staff-officer with a formation co-ordinates the work of the representatives of the various branches, though

he does not interfere in the working out of details.

The adjutant-general's branch is responsible, among others, for the following questions: discipline and military law, supply of personnel, honours and rewards, sanitation, casualties, and routine duties.

The quartermaster-general's branch deals with questions relating to supplies, i.e. food, forage, &c., equipment and ammunition, transport, quarters, remounts, and veterinary affairs.

It has been suggested that in the future it may be found possible to abolish the dividing lines between the three branches, and to have one staff dealing with questions of every kind, but at present the three-branch system is in vogue. The chief of the imperial general staff is the official adviser of the Government on military matters.

The red gorget patches, formerly worn by all staff-officers of whatever grade, have now been abolished for all below the rank of general officer in favour of distinctive coloured armlets. The colour of these armlets varies according to whether the officer is serving on the War Office staff, or that of a command, division, or brigade, that for the War Office being French grey with the letter G, A, or Q; for a command, red, black, red; a division, red; and a brigade, blue, in each case with the appropriate letters denoting branch or appointment.

Officers of the G branch hold appointments such as general staff-officer, grade 1, 2, or 3; those of the adjutant-general's or quartermaster-general's branches as deputy, assistant, or deputy-assistant adjutant or quartermaster-general.

Generation, a single succession of human beings (or animals) who are born, grow up, and reproduce their kind; hence, an age or period of time between one succession and the next, as the third, the fourth, or the tenth generation. The length of a human generation is usually estimated at about thirty years.

Generation, Spontaneous, or Abiogenesis, the doctrine that living matter may originate spontaneously, 'that under certain circumstances dead matter may build itself up into living matter without the intervention of already existing protoplasm'. In the seventeenth century this was the dominant view, sanctioned alike by antiquity and authority, and was first assailed by Redi, an Italian philosopher, who proved that flies are not thus generated. Buffon held the doctrine in a very modified degree. He was of opinion that life is the indefeasible property of certain indestructible molecules of matter which exist in all living things, and have inherent activities by which they are distinguished from not-living matter, each individual living organism being formed by their temporary

combination. Since the time of Redi it is only animals or plants of very low type and minute size that have been supposed thus to be produced spontaneously from dead matter; and the readiness with which such appear, in circumstances in which one might suppose no germs of them could be present, gives some countenance to the belief. But there is every reason to believe that, whatever may have been the case with the first beginnings of life, living matter is now invariably derived from pre-existent living matter.

Generations, Alternation of. (a) *In Plants*.—This phenomenon, rare among the lower forms (Thallophytes), becomes a constant and important feature in the higher groups (Cormophytes). It is seen in its most obvious form in the Ferns (q.v.), where the life-history comprises two distinct phases, the familiar fern-plant being the neutral or asexual generation or *sporophyte*, which ends with the production of asexual *spores*. When sown, these spores give rise not to a new fern-plant but to the prothallus or *gametophyte*, a small cellular structure which, as its name implies, produces *gametes*, viz. *spermatozooids* from antheridia and *egg-cells* in archegonia. An egg-cell, when fertilized, grows into a young fern-plant, which is at first (the embryo stage) parasitic on the prothallus, but soon becomes independent. In this case the different generations are easily distinguished, the sporophyte being a large, long-lived vascular plant, whereas the gametophyte is small, cellular, and transient. Conversely, in Mosses and Liverworts the 'plant' is the gametophyte, and the sporophyte or *sporogonium* never becomes independent, but serves only for the production and dispersal of the spores. In other cases the two phases are not so distinct, e.g. in the Red Seaweed (Polysiphonia), where the sexual and neutral plants are externally indistinguishable except by their reproductive organs, or in the Angiosperms, where the gametophyte phase is practically suppressed. The 'nuclear cycle', which goes hand in hand with alternation of generations, furnishes a reliable means of distinguishing between the two phases, though it is not easy of application. At each fusion of gametes, the number of chromosomes is doubled, and if there is a sporophyte phase, this double (*diploid*) number persists up to the formation of spores, when reduction to the single (*haploid*) number characteristic of the gametophyte takes place.

(b) *In Animals*.—The phrase 'alternation of generations' is applied to the life-histories of animals when these consist of two or more distinct stages which reproduce in a different way, and might be mistaken for distinct species. Among some of the hydroid zoophytes (Cœlenterata), for example, a fixed branching colony of

polypes gives rise by budding to little free-swimming sexual jelly-fishes (medusæ), the fertilized eggs of which, instead of producing other jelly-fishes, develop into branching colonies. Such an alternation of an asexual with a sexual form is known as *metagenesis*. A well-known jelly-fish (Aurelia) of larger size is the sexual stage of a similar life-history, derived from a single fixed polype by transverse division. Each such polype produces a number of medusæ in this way, which are at first placed on top of one another, like a pile of saucers, afterwards breaking away and growing to full size. Another well-known case is that of the transparent salps, marine creatures which are among the lowly relatives of the back-boned animals. Here a solitary asexual form gives rise by budding to a chain of sexual individuals. Alternation of generations also included what is known as *heterogeny*, where the life-history not only includes a sexual stage in which the eggs are fertilized, but also a series of females of which the eggs develop without being fertilized, i.e. by *parthenogenesis*. This is illustrated by the common aphides popularly known as 'green fly', in which during the summer a large number of generations of females are produced parthenogenetically, these being born alive (viviparously). In the autumn, however, the last generation of such females lays eggs from which both males and females hatch out. Examples of heterogeny are common among some of the parasitic worms, e.g. the liver-flukes, but here the life-history is still more complex.

Generator. *Electric generators*, or dynamo-electric machines, may be divided into two classes, each of which may be again divided into two groups: *Class 1*, generators of direct-current electricity, or *dynamos*; and *Class 2*, generators of alternating-current electricity, or *alternators*. Each of these classes is divided into *Group A*, high-speed machinery; *Group B*, medium- and low-speed machinery.

High-speed alternators are usually driven by steam-turbines, and the whole set is called a *turbo-alternator*. Medium- and low-speed alternators are used with water-wheels in hydro-electric installations. High-speed dynamos are comparatively rare nowadays. When steam-turbines are used to drive them, a single reduction gearing is often used, so that the turbine can run at a high speed and the dynamo at a medium speed. Medium- and low-speed dynamos are very common, and are driven by steam-turbines—through gearing—reciprocating engines, water-wheels, gas-engines, &c.

Speeds.—Speeds from 75–400 r.p.m. may be regarded as low speeds; from 400–1000 r.p.m., say, as medium speeds, and above 1000 r.p.m. as high speeds. For a generator of a given

output there is a certain 'best' speed at which the weight and therefore the cost of the machine is a minimum.

Principles.—The leading principles underlying the action of all dynamo-electric machinery are the same. Faraday discovered in 1831 that when the magnetic flux through a coil of wire changes, an electromotive force is set up in the coil. This e.m.f. is proportional to the rate of change of the flux. A powerful magnetic field is created by means of a large electromagnet, between the poles of which an 'armature' revolves. This armature consists of a core of soft iron carrying coils embedded in the periphery of it through which the magnetic field passes. The armature is caused to revolve and the coils revolve with it, hence the magnetic field—the 'flux' as it is called—which passes through them, changes. An electromotive force is therefore induced in the armature coils, and if these coils are closed by connecting the terminals of the machine to an outside circuit, an alternating current of electricity will flow (see *Electricity*).

Aim in Design.—The general aim of the designer is to produce the machine required with the minimum amount of material. This will naturally lead to the cheapest machine. To this end the designer will use the highest current-densities he can in the armature conductors, and the highest magnetic flux-densities in the iron parts of the magnetic circuit. These quantities are limited by the heating of the machine.

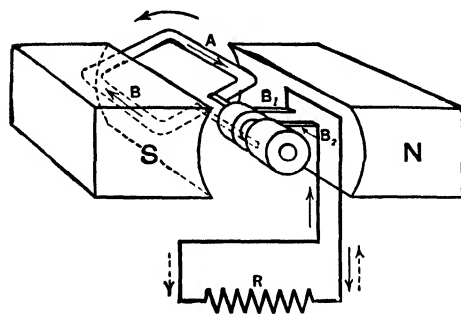
Temperature Rise.—The insulation of the armature conductor is very sensitive to temperature and temperature changes, and its temperature must not be allowed to exceed a certain limit. This limit depends on the kind of insulation used, and rarely exceeds about 80° C. If, then, the normal atmospheric temperature is 20° C., we have a permissible rise of temperature of 60° C.

Heating of Machine.—The heating of the machine arises from two main causes: (1) the losses arising from the circulation of the current in the armature coils—the I^2R loss as it is called; and (2) the changes in the magnetic state of the iron of which the armature core is composed—the 'iron' or 'core' losses. The former depends upon the current density, the latter on the magnetic flux density; and these quantities must be limited to such values that the temperature of the machine does not exceed the prescribed limit.

Ventilation.—The great importance of ventilation will now be evident. The harder we blow the machine with cold air the greater will be the heat we can get rid of without exceeding the temperature rise permitted, and hence the higher

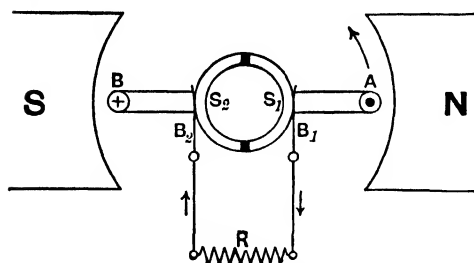
the current and flux densities we can use. All medium turbo-alternators are ventilated by special fans, and the air used amounts to about $\frac{1}{2}$ lb. per minute per kw. These heating limitations apply to all dynamo-electro machinery.

Dynamos.—The special problem of dynamo design, as distinct from alternator design, is the design of the 'commutator'. If the ends of the coil AB were brought out to a pair of slip



Simple Loop Dynamo

rings, as shown in the figure above, the e.m.f. between B_1 and B_2 would be an alternating one, and this pressure would give rise to an alternating current in the external circuit R . In a dynamo we want a constant pressure, and so a device called a 'commutator' is introduced. In the figure a very simple commutator in two portions



Simple Loop with Commutator

is shown. The two ends of the loop AB are connected, not to slip rings, but to a split metal ring (the commutator), the two halves of which S_1 and S_2 , are insulated from each other. Two brushes, B_1 and B_2 , are so placed as to press on diametrically opposite parts of the commutator. In the figure, the current is flowing from wire A to segment S_1 , then through brush B_1 , the external circuit, brush B_2 , segment S_2 , to wire B, and so returns to A; but it will be seen that when A passes just out of the influence of pole N and begins to come into the influence of pole S, the spring B passes from one segment of the commutator to

the other. The result is that the current in R is always in one direction; it is very fluctuating, as the pressure varies between nothing and the maximum value, but it is never reversed. By making the commutator in a great many segments, the pressure can be kept practically constant. The design of the commutator offers both mechanical and electrical difficulties. The former arise from the fact that it is a complex structure of comparatively thin bars of copper held at the ends only, and the latter from the sparking which may occur at the brushes. Both difficulties increase with the speed of the machine, and they become almost insurmountable at the speeds of steam-turbines. Hence dynamos driven by steam-turbines are now usually driven through a single reduction gearing.

Alternators.—The alternator has no commutator, and herein lies its superiority over the dynamo as a generator of electricity. There is no a priori reason why the armature should revolve at all; all that is necessary is that the armature shall revolve *relative* to the magnets. This can be secured by keeping the armature fixed and revolving the magnets, and, as there is no commutator to be considered, there is distinct advantage in so doing as the magnets are the simpler mechanical structure of the two. In all large alternators the field magnets revolve. There is no commutator to limit the speed, and so the alternator rotor is usually coupled direct to the engine, be it a slow-speed one or a steam-turbine.

Turbo-alternators.—Special mechanical difficulties arise in the design of turbo-alternators from the high speeds used.

Stresses.—A very common speed for a turbo-alternator, is 3000 r.p.m. The force on a piece of matter on the outside of a cylindrical rotor, of 1 foot radius, rotating at this speed, is about 3000 times its weight. Thus the force on 1 lb. becomes roughly $1\frac{1}{2}$ tons weight. This is due to centrifugal action. The stresses set up by centrifugal action thus become very great, and require the best material and the highest skill in design to be successfully and safely used.

Vibration.—The different parts of an alternator, such as any bolts in it, its rotor, &c., can vibrate, and each part has a set of definite frequencies at which it can be made to vibrate very easily. The lowest of these is usually called the *fundamental* frequency. The fundamental frequencies, for certain parts, are often fairly low, say about 40 cycles per second, because the stiffness of these parts is relatively small compared to their mass. For instance, a long, relatively thin bolt passing through the alternator from end to end may have a fundamental frequency of 40 cycles per second, say. Low-speed machines are distinguished by a relatively

large ratio of diameter to length, hence the parts are relatively much stiffer and have much higher fundamental frequencies. Now the long bolt mentioned above, having a fundamental frequency of 40 cycles per second, would synchronize with any disturbing alternating forces that might arise in an alternator giving current at the same frequency, 40 cycles per second. Resonance would not be likely to happen in the low-speed machine, because the fundamental frequency of the bar would be much higher. This possibility of resonance is one of the evils of turbo-alternators. It may be a counsel of perfection, but the only way to avoid resonance is to design every part of the machine so that its fundamental frequency is higher than that corresponding to the running speed of the machine.—BIBLIOGRAPHY: *Modern Electrical Engineering* (The Gresham Publishing Company); Miles Walker, *Design and Specification of Dynamo-Electric Machinery*; A. Gray, *Electrical Machine Design*.

Generic Name, in natural history, the denomination which comprehends all the species of a genus: thus *Canis* is the *generic* name of animals of the dog kind; *Felis*, of the cat kind; *Cervus*, of the deer kind. See *Genus*.

Genesee (jen-e-sē'), a river of the United States, which rises in Pennsylvania, flows north through New York, and falls into Lake Ontario 6 miles below Rochester, after a course of 145 miles. It is notable for its varied and romantic scenery, and its extraordinary falls. These falls are five in number; three of them occur about 90 miles from the mouth of the river, and are respectively 60, 90, and 110 feet high. The other two are near Rochester, and are both about 100 feet high.

Genesis (Gr., creation, birth, origin), the first book of the Bible and of the Pentateuch, named in the Hebrew canon *B'reshith* (in the beginning), from the term with which it commences. From the Greek translators it received the name by which it is now commonly known. *Genesis* consists of two great but closely-connected divisions: (1) The history of the creation, the fall of man, the flood, the dispersion of the human race, chap. i-xi. (2) The history of the fathers of the Jewish race, chap. xii-l. A certain apparent difference of style and language, the occurrence of what seem gaps on the one hand, and repetitions and contradictions on the other, and the different use of the term for the divine name (*Jehovah*, Everlasting; and *Elohim*, Almighty) led very early to the question of the integrity of the book, and various critics have assumed larger or smaller interpolations. See *Bible*.—BIBLIOGRAPHY: W. H. Green, *Unity of Genesis*; A. R. Gordon, *Early Traditions of Genesis*.

Genet (jen'et), a digitigrade carnivorous mam-

mal of the family Viverridae. The genus *Genetta* contains five species, the best known of which is the *G. vulgaris*, the common genet, whose range extends all around the Mediterranean, including Western Asia, Northern Africa, and Southern Europe. It is about the size of a small cat, but of a longer form, with a sharp-pointed snout, upright ears, and a long tail. It has a beautiful soft fur. The habits of the genet are like those of the weasel tribe; it is easily tamed,



Genet (*Genetta vulgaris*)

and is sometimes employed in Constantinople and elsewhere to catch rats and mice.

Genetic Psychology (Gr. *genesis*, origin), the science of the mind as concerned with mental evolution, development, and growth of consciousness. It deals with the growth of ideas in the minds of children and adult human beings, and with the development of intelligence from the lowest species of animals to the most perfect races of man. Genetic psychology is a branch of experimental psychology inaugurated by Lotze, and is psychology as viewed from a particular standpoint. It covers the departments of child-psychology (the development of the individual mind), of race-psychology (mental evolution in the animals and man), and of folk-psychology (differential forms in the human species). Thus genetic psychology is concerned with the developments of minds from simple beginnings into complex forms.—Cf. E. A. Kirkpatrick, *Genetic Psychology*.

Geneva (from Fr. *genièvre*, Lat. *juniperus*, juniper), a spirit distilled from grain or malt, flavoured with juniper berries. The word is now usually in the form *gin*. Also called *Hollands*. See *Gin*.

Geneva (je-nē'va; Ger. *Genf*, Fr. *Genève*), a town of Switzerland, capital of the canton of the same name, situated at the western extremity of the Lake of Geneva, where the Rhône issues, here crossed by several bridges, and dividing the town into two portions, the larger and more important of which is on the left or south bank. The environs are covered with handsome villas, and the town itself, when

approached either by land or water, has a very attractive appearance. It was formerly surrounded by walls and regular fortifications, but since 1850 these have been removed. The town is divided into two parts, an upper and a lower. The upper town, occupied chiefly by the wealthier citizens, consists of well-built houses and handsome hotels; the lower town, the seat of trade and residence of the poorer classes, consists largely of houses remarkable for their height, and forming narrow, irregular streets. The more important public buildings are the cathedral or church of St. Pierre, a Gothic structure of the tenth, eleventh, and twelfth centuries, which, somewhat defaced externally by a very incongruous Greek peristyle, occupies the highest site in the town, and with its three towers forms the most conspicuous object within it; the town house in the Florentine style; the Musée Rath, containing a collection of pictures and other works of art; the university building, nearly opposite the botanic garden, rebuilt between 1867 and 1871, and containing the public library, founded by Bonivard, the prisoner of Chillon, in 1551, and now numbering 150,000 volumes; and the Museum of Natural History. The only important manufactures of Geneva are those of watches, musical-boxes, and jewellery, for all of which the town is justly famed. Geneva has ample railway communication, and is one of the principal entrances for tourists and travellers into Switzerland. In literature and science Geneva has long occupied a distinguished place, and it has been the birth-place or the residence of many eminent men, including Calvin, Beza, Knox, Le Sage, Necker, De Candolle, Rousseau, and Sismondi. Geneva early adopted the principles of the Reformation, and chiefly through the teaching of Calvin the town acquired an important influence over the spiritual life of Europe, and became the centre of education for the Protestant youth of Britain, France, and Germany. In 1920 Geneva was selected as the official seat of the Council of the League of Nations, and the first assembly opened on 15th Nov. Pop. 155,738.—*Cf. G. Fatio and F. Boissonnas, Genève à travers les siècles.*

Geneva, Canton of, is bounded by the canton of Vaud and the Lake of Geneva, and by France. Area, 109 sq. miles. It belongs to the basin of the Rhône, and the only streams of importance are that river and the Arve, which joins it a little below the town of Geneva. The soil has been so much improved by skilful and persevering culture that abundant crops of all kinds suitable to the climate are raised, and the whole territory wears the appearance of a garden. Manufactures consist chiefly of clocks and watches, musical-boxes, mathematical instruments, gold, silver, and other metal wares,

woollen cloths, and silk goods of various descriptions, hats, leather, and articles in leather; and there are numerous cotton-mills, calico-printing works, and dyeworks. The territory of Geneva having, by the arrangements of the Congress of Vienna, obtained an accession of fifteen communes, detached from France and Savoy, was admitted a member of the Swiss Confederation in 1814, and ranks as the twenty-second canton. Its Constitution of 1848 is the most democratic in the Federation. All religious denominations are declared to have perfect freedom, but two of them are paid by the State—the Roman Catholics, amounting to rather more than a third of the population, and the Protestant National Church. The language spoken is French. Pop. 170,323.

Geneva, Lake of, or Lake Lemman (Lat. *Lacus Lemanus*), the largest of the Swiss lakes, extending in the form of a crescent, with its horns pointing southward, between France on the south, and the cantons of Geneva, Vaud, and Valais: length, measured on its north shore, 55 miles, and on its south shore 40 miles; central breadth, about 6 miles; area, 224 sq. miles; greatest depth, 900 feet. It is 1150 feet above the sea. On the north the shore is low, and the ground behind ascends gradually in beautiful slopes. On the south, and particularly at the east end, the shore is rocky and abrupt, and lofty precipices often rise sheer from the water's edge. It contains various species of fish, and its water is remarkably pure and of a beautiful blue colour. The Rhône, which enters its eastern extremity a muddy turbid stream, issues from its western extremity perfectly pellucid, and of the finest blue.

Geneva Bible, a copy of the Bible in English, printed at Geneva; first in 1560. This copy was in common use in England till the version made by order of James I was introduced, and it was laid aside by the Calvinists with reluctance.

Geneva Convention, an agreement concluded at an international conference held in Geneva in 1864, for the succour of the sick and wounded in time of actual warfare. The neutrality of hospitals, ambulances, and the persons attending on them was provided for; and the use of the red cross on a white ground as a sign of neutrality has received the adhesion of all civilized powers.

Geneviève (jen'e-vêv or zhén-vi-äv), the name of two women, well-known in legend.—(1) St. Geneviève, the patron saint of Paris, born at Nanterre, about 5 miles from Paris, in the year A.D. 423, died at Paris about the beginning of the sixth century. She devoted herself while yet a child to the conventual life. Her prayers and fastings are credited with having saved Paris from the threatened destruction by Attila

in 451. Many legends are told respecting her, and several churches have been dedicated to her. Her festival is held on the 3rd Jan.—(2) Geneviève, by birth Duchess of Brabant, wife of Siegfried, Count Palatine in the reign of Charles Martel (about A.D. 750). According to the legend, which is the subject of several tales and dramas, she was accused of adultery during her husband's absence and condemned to death; but was allowed to escape, and lived six years in a cavern upon nothing but herbs. She was finally found, and carried home by her husband, who in the meantime had become convinced of her innocence.

Genghis Khan, or **Jenghis Khan** (jen'gis), Mongol conqueror, born about 1160, died 1227. His father was chief over thirty or forty clans, but paid tribute to the Tartar Khan. He succeeded his father when only fourteen years of age, and made himself master of the neighbouring tribes. A great number of tribes, however, combined their forces against him, and a war of several years was the result. Genghis Khan was compelled to retire to Karakorum, where he found a powerful protector in the great Khan of the Karaite Mongols, Oung, or Ung, who gave him his daughter in marriage. After much intestine warfare with various Tartar tribes, Genghis was proclaimed Khan of the United Mongol and Tartar tribes. He now professed to have a divine call to conquer the world, and the idea so animated the spirit of his soldiers that they were easily led on to new wars. The country of the Uigurs, in the centre of Tartary, had long excited his ambition. This nation was easily subdued, and Genghis Khan became master of the greater part of Tartary. Soon after, several Tartar tribes put themselves under his dominion, and in 1209 he passed the great wall of China. The conquest of China occupied the Mongols more than six years. The capital, then called *Yenking*, now *Peking*, was taken by storm in 1215 and plundered. The murder of the ambassadors whom Genghis Khan had sent to the King of Kharism (now Khiva) occasioned the invasion of Turkestan in 1218 with an army of 700,000 men; and the two cities of Bokhara and Samarkand were stormed, pillaged, and burned. Seven years in succession was the conqueror busy in the work of destruction, pillage, and subjugation, and he extended his ravages to the banks of the Dnieper. In 1225, though more than sixty years old, he marched in person at the head of his whole army against the King of Tangut (South-Western China), who had given shelter to two of his enemies, and had refused to give them up. A great battle was fought, in which the King of Tangut was totally defeated with the loss of 300,000 men. The victor remained some time in his newly subdued provinces, from

which he sent two of his sons to complete the conquest of Northern China. At his death his immense dominions were divided among his four sons.—Cf. R. K. Douglas, *Life of Genghis Khan*.

Genii, tutelary deities; the ruling and protecting powers of men, places, or things; good or evil spirits supposed to be attached to a person and influence his actions. The Genii of the Romans were the same as the *Daimōnes* (Demons) of the Greeks. According to the belief of the Romans which was common to almost all nations every person had his own Genius, that is, a spiritual being, which introduced him into life, accompanied him during the course of it, and again conducted him out of the world at the close of his career. The Genii of women were called *Junones*. The Genii were wholly distinct from the *Manes*, *Lares*, and *Penates*, though they were allied in one important feature—the protection of mortals.

The term *genii* (with the singular *genie*) is also used as equivalent to the *jinn* (singular *jinnē*) of Arabic tales. These are supposed to be a class of intermediate beings between angels and men. See *Jinn*; *Demonology*.

Gen'ipap (*Genipapo*, the Guiana name), the fruit of a South American and West Indian tree, the *Genipa americana*, nat. ord. Rubiaceæ. It is about the size of an orange, and of a pleasant vinous flavour.

Genis'ta, a genus of leguminous plants, comprising about 100 species, one of which is the *Planta genista*, the *Plante genêt*, from which the Plantagenets took their name. The *Genista tinctoria*, or dyer's broom, so called, as it was formerly much employed by dyers, who obtained a good fixed yellow or orange colour from it, is frequent in England and the Lowlands of Scotland.

Genius. The term is applied not only to the highest and most unusual degree of mental superiority, but also, in a concrete sense, to the person endowed with such superiority. Men endowed with superior faculties are, as a rule, one-sided, i.e. they are mediocre, and even limited, in spheres lying outside their own particular domain and in which they excel. We speak of a political, philosophical, mathematical, literary, or scientific genius. History knows only a very few men who were universal geniuses. Genius is to be distinguished from talent. The former implies innate individuality and originality. It manifests itself and creates *spontaneously*, involuntarily, and, so to say, unconsciously. Ideas and conceptions spring ready-made—Minerva-like—from the brain of the individual who is a genius, his spontaneity being like that of an explosive. Again, no amount of work, education, and methodical training will develop genius, whilst talent can be fostered, developed, and strengthened by these means.

Talent, unlike genius, works methodically and consciously. It may be defined as conscious, teleological activity, whilst genius is spontaneous, inspirational, and highly original. Genius creates, while talent avails itself of the creations of genius, is inspired by them, interprets, modifies, and applies. Genius is unconventional, knows no laws, and is not influenced by the rules and regulations of others; it is self-sufficient. It creates new values, and solves problems hitherto considered as insoluble. Talent, on the other hand, is conventional, moves and lives and has its being within the boundaries traced by others. Genius has been defined in many various ways. Carlyle defined it as "the transcendent capacity of taking trouble first of all", whilst scientists define the man of genius as "one born with potential energy". Others describe genius as the "capability of grasping what is essential in all things". According to Schopenhauer, genius is "the completest objectivity", whilst Goethe said that "the first and last thing which is demanded of genius is the love of truth". The problems of the origin and characteristics of genius, the hereditary character of mental superiority, and the relations between genius and insanity have been frequently discussed in the light of science. Sir Francis Galton, in his *Hereditary Genius* (1874), has shown the hereditary nature of greatness, and the transmission of mental endowment, whilst the relation between genius and insanity has been studied by Moreau de Tours, as well as by C. Lombroso and Max Nordau. The relation of genius and of great men to historical movements and environment, and the question whether the great man is the cause or effect of social evolution, is another interesting problem which is being frequently discussed.—
BIBLIOGRAPHY: Sir F. Galton, *Hereditary Genius*; C. Lombroso, *The Man of Genius*; J. F. Nisbet, *The Insanity of Genius*; Max Nordau, *Degeneration*; H. Türck, *The Man of Genius*; O. L. Schwarz, *General Types of Superior Men*.

Genlis (zhân'lēs), Stéphanie Félicité Ducrest de St. Aubin, Comtesse de, French authoress, born near Autun 1746, died at Paris 1830. At four years of age she was admitted as a canoness into the noble chapter at Aix, and at seventeen married the Comte de Genlis. By this marriage she became niece to Madame de Montesson (who had been privately married to the Duc d'Orléans), and obtained through her the place of lady-in-waiting to the Duchesse de Chartres. In 1782 the Duc de Chartres (Philippe Égalité) appointed her governess of his children. She obtained great influence over her employer, and was the object of no little scandal in her relations with him, which was strengthened by the mysterious appearance of an adopted daughter, afterwards

known by the name of Pamela, who married Lord Edward Fitzgerald. At this time she published several works on education. On the breaking out of the Revolution she retired for a while to Switzerland, and then to Altona. In 1800 she returned to France, and gained the favour of Napoleon, who gave her a pension. From that time she resided constantly in Paris. Her works, which embrace a wide variety of subjects, amount altogether to about ninety volumes, and include some of the standard novels in the French language. Her voluminous *Mémoires*, written when she was upwards of eighty years of age, abound in scandal, and are full of malignant attacks upon her contemporaries.—
Cf. Jean Harmond, *A Keeper of Royal Secrets*.

Genoa (jen'o-a; It. *Genova*, 'La superba'), a seaport of North Italy, the chief commercial city of the kingdom, on the coast of the Mediterranean, at the head of the gulf of the same name, 75 miles S.E. of Turin. It is beautifully situated at the foot and on the slope of the Ligurian Alps, the lower hills of which form a background to the city. It is enclosed by extensive fortifications, and the heights around are crowned with detached forts. It has a most imposing effect when approached either by land or sea. In the older parts of the town the streets are extremely narrow, with lofty buildings on either side. In the newer quarters many of them are spacious, and are lined with palaces and other noble edifices. Some of the palaces are filled with works of art by the greatest masters. The principal are: the Ducal palace (the old residence of the Doges, remodelled in later times and now containing the law courts and various public offices); the Palazzo del Municipio or town hall; the Palazzo Brignole or Rosso (presented to the city by the Duchess Galliera in 1874, along with its contents, including the largest picture-gallery in Genoa, and a valuable library); Palazzo Bianco (bequeathed by the same lady with its art treasures and now the museum); the Palazzo Marcello-Durazzo or Durazzo-Pallavicini; the Palazzo Reale (Royal Palace), built in the seventeenth century for the Durazzo family, purchased in 1815 by the royal family, and restored in 1842; and the palaces of Doria, Spinola, Cambiaso, and Balbi-Senarega. The most remarkable of the churches is the Duomo, or cathedral of St. Lorenzo, founded in the eleventh century, but not completed till the beginning of the twelfth, and greatly altered in subsequent centuries, so that it now exemplifies three distinct styles, Romanesque, French Gothic, and Italian Renaissance. Other churches are those of S. Maria in Carignano, built in imitation of the original plan of St. Peter's at Rome; S. Stefano, a Gothic church, the oldest parts of which date from the end of the twelfth century;

S. Ambrogio, containing two paintings by Rubens, and the *Assumption* of Guido Reni. The principal charitable institution is the Albergo de' Poveri, in which 1600 individuals, orphans and old people, find shelter. Others are the Ospedale del Pamatone, founded in 1430; and a hospital built by the Gallicra family. Among the theatres of the city may be mentioned the Teatro Carlo Felice, a graceful building, with a splendidly appointed interior. Besides the university, re-founded in the eighteenth century (1100 students), the chief educational institutions are the theological seminary, the school of fine arts, the royal marine school, the navigation school, various secondary schools, &c. The building of the Bank of St. George, one of the most ancient banks of circulation and deposit in Europe, now contains the archives. In one of the open spaces there is a fine marble statue of Columbus, with accompanying allegorical figures. There are also statues of Victor Emmanuel, Garibaldi, Cavour, and Mazzini. The Campo Santo, or cemetery, about 2½ miles from the city, is one of the most beautiful burial-grounds in Europe. It contains fine mortuary buildings and much statuary in white marble.

The manufactures of Genoa include cotton and silk goods, gold, silver, paper, and leather goods, sugar, and preserved fruits; there are also engineering, shipbuilding, and other industries. Its connections by rail with the St. Gothard Tunnel make Genoa one of the chief Mediterranean ports. The old harbour, which is of a semicircular form and about ¾ mile in diameter, is formed by two moles projecting into the sea from opposite sides; there are now also two outer or additional harbours formed by moles recently constructed, and there are also graving-docks, a naval harbour, and marine arsenal. Genoa is an important outlet for goods sent by sea from North Italy and Switzerland, and is of still greater importance for goods entering by sea. The principal articles of export at present are silk, oils, wine, fruit, cheese, rags, and the products of its manufactures. Among the chief imports are cotton, wool, wheat, sugar, coffee, coal, hides, and iron. Great quantities of British coal are imported. The annual exports amount to about £20,000,000, and the imports to about £40,000,000. Many emigrants embark there.

Under the Romans, Genoa was famous as a seaport. After the breaking up of the empire of Charlemagne, it constituted itself a republic, presided over by Doges. From 1119 it was almost constantly at war with Pisa down to 1284, when it inflicted a crushing defeat on the latter town. The Genoese obtained the supremacy over Corsica, and nominally over Sardinia, possessed settlements in the Levant, on the shores of the Black Sea, on the Spanish and

Barbary coasts, and had a very flourishing commerce. The rivalry between Genoa and Venice was a fruitful source of wars during the twelfth, thirteenth, and fourteenth centuries. Meanwhile the city was convulsed by civil discord and party spirit. The hostility of the democrats and aristocrats, and the different parties among the latter, occasioned continual disorder. From the contests of noble rivals, in which the names of Doria, Spinola, Grimaldi, and Fieschi are prominent, Genoa was drawn into the Guelph and Ghibelline contest. The city sometimes submitted to a foreign yoke in order to get rid of anarchy. In the midst of this confusion St. George's Bank was founded. It owed its origin to the loans furnished by the wealthy citizens to the State, and was conscientiously supported by the alternately dominant parties. In 1528 the disturbed state regained tranquillity and order, which lasted till the end of the eighteenth century. The form of government established was a strict aristocracy. The nobility were divided into two classes—the old and new. To the old belonged, besides the families of Grimaldi, Fieschi, Doria, and Spinola, twenty-four others, who stood nearest them in age, wealth, and consequence. The new nobility comprised 437 families. Gradually, however, Genoa lost all her foreign possessions. Corsica, the last of all, revolted in 1730, and was ceded in 1768 to France. After the battle of Marengo (1800) Genoa was taken possession of by the French. In 1805 it was formally annexed to the Empire of France, and in 1815 the Congress of Vienna awarded the town to the Kingdom of Sardinia, with which it became a portion of the Kingdom of Italy. Pop. 300,139. The province of Genoa has an area of 1582 sq. miles, and a pop. of 1,119,877.—*Cf. Bent, Genoa: how the Republic Rose and Fell.*

Genoa, Gulf of, a large indentation of the Mediterranean, in North Italy, at the head of which lies the city and port of Genoa. No precise points can be named as marking its entrance; but it may, perhaps, be generally said to comprise the entire space north of lat. 43° 40' N.

Genre-painting (zhăn-r), that branch of painting in which are depicted scenes of everyday life, in contrast, for instance, to historical painting, in which historical or mythological events are portrayed, or to landscape. Genre-painting was practised by the Greek artists, especially by the Alexandrian school, and in the fifteenth and sixteenth centuries by Ghirlandaio, Giorgione, and Peeter Brueghel. Watteau, Boucher, and Fragonard in France, and Hogarth in England, were famous genre-painters.

Gens, in Roman history, a clan or stock embracing several families united together by a common name and certain religious rites; as, the Fabian *gens*, all having *Fabius* as part of

their personal name; and the Julian *gens*, all named Julius.—Cf. article in Smith's *Dictionary of Greek and Roman Antiquities*.

Genseric (jen'), or **Gaiseric**, a king of the Vandals, who, having obtained joint possession of the throne of Spain with his brother Gonderic, crossed the Straits of Gibraltar with 50,000 men, A.D. 429, on the invitation of Bonifacius, the Roman governor of Africa, to assist him against the Moors. He, however, soon declared his independence, and, having completely defeated Bonifacius, founded a kingdom, which in 439 had its seat at Carthage. He collected a powerful fleet, ravaged the coasts of Sicily and Italy, and in 455 took and sacked Rome. Two unsuccessful attempts were made by the Eastern and Western emperors to overthrow his power, but Genseric secured all his conquests, and, notwithstanding all his cruelties, was permitted to die in peace A.D. 477.

Gentian, the name given to the members of the genus *Gentiana* (ord. *Gentianaceæ*), a large

is used medicinally, and also as an ingredient of cattle foods. In Switzerland and Bavaria a liqueur called *Enziangeist* or 'gentian-spirit' is made from it. Many of the blue-flowered species, as *G. acaulis*, *G. nivalis*, and *G. verna*, are among the most conspicuous and ornamental of European alpine plants. Five species are British.

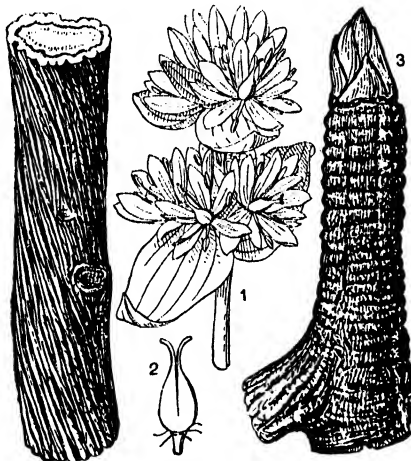
Gentiana'ceæ, the gentians, an order of gamopetalous Dicotyledons, consisting mostly of annual or perennial herbaceous plants, with opposite often connate entire leaves, and yellow, red, blue, or white flowers, which are borne in dichotomous or trichotomous cymes or in globose terminal heads. All are characterized by their bitter principle. The order contains about 800 species, which are widely dispersed throughout the world, occurring most plentifully in temperate mountainous regions. Some very handsome species are tropical, while a few occur in Arctic latitudes.

Gentile, in Scripture, anyone belonging to the non-Jewish nations and not a Christian; a heathen. The Hebrews included in the term *goyim*, or nations, all the tribes of men who had not received the true faith, and were not circumcised. The Christians translated *goyim* by the Lat. *gentes*, nations, and imitated the Jews in giving the name *gentiles* to all nations who were not Jews or Christians. In civil affairs the denomination was given to all nations who were not Romans.

Gentleman, in English law, every man above the rank of yeomen, including noblemen; in a more limited sense, a man who without a title bears a coat of arms, or one who is 'a gentleman by reputation', through belonging to some liberal profession or holding some office giving him this rank. The term is now by courtesy applied to almost every adult male. In a narrower sense the term gentleman is used as synonymous with the Fr. *gentilhomme*, denoting a man of noble blood and race. Chaucer's definition of a gentleman is a man who is virtuous and performs gentle deeds.

Gentlemen-at-Arms, a body of forty gentlemen, headed by a captain, lieutenant, and standard-bearer, whose duties are to form a body-guard to the British sovereign on State occasions. The corps was established by Henry VIII in 1509, under the name of the Band of Gentlemen Pensioners. Appointments to the corps are made by the sovereign, from a special list of retired officers.

Gentz (gents), Friedrich von, a German diplomatist and publicist, born 1764, died 1832. He was secretary to the Directory of Finances at Berlin when the French Revolution, of which he was an ardent opponent, broke out. He served alternately in the Prussian and Austrian civil



Yellow Gentian (*Gentiana lutea*)

1, Upper part of flower spike. 2, Fruit. 3, Part of rhizome. 4, Part of root.

genus of bitter herbaceous plants, having opposite, often strongly ribbed, leaves, and blue, yellow, or red, often showy flowers. The calyx consists of four or five valvate segments, and the corolla is four or five parted; the fruit is a two-valved one-celled, many-seeded capsule. They are for the most part natives of hilly or mountainous districts in the northern hemisphere. The most important species is *Gentiana lutea*, a native of Switzerland and the mountainous parts of Germany. The root has a yellowish-brown colour and a very bitter taste, and is imported into Britain in considerable quantities, where it

service, and his pamphlets and manifestoes proved formidable obstacles to the invasions of Napoleon. He took part in the Congresses of Vienna and Paris, as well as in others. Among his various works was a *Life of Mary Queen of Scots*.

Genuflexion (from the Lat. *genu*, knee, and *flectere*, to bend), the act of bending the knees in worship. There are frequent allusions to genuflexion in the Old and New Testaments, and it would appear that the use was continued among the early Christians. It is a modification of the Oriental custom of prostration. Genuflexion obtains, both by rule and prescription, in various places in the offices of the Roman Catholic Church, and has been adopted to some extent by the Ritualistic wing of the Church of England.

Genus, in biological classification, an assemblage of species possessing certain characters in common, by which they are distinguished from all others. It is subordinate to *family* in animals and *natural order* in plants. A single species, possessing certain peculiar characters which belong to no other species, may also constitute a genus, as the duck-billed platypus (*Ornithorhynchus*).

Geodes (jĕ'ōdz), round hollow nodules, containing sometimes earthy matters, sometimes a deposit of agate, sometimes quartz and other crystals. They are found more or less in all volcanic rocks, and have been formed by water depositing their materials in the hollows of those rocks.

Geodesy. The science of geodesy deals with the shape and dimensions of the earth, its density, and its attraction. It may be considered to have two sides, the experimental and the deductive. For the data from which its deductions are drawn it depends mainly upon the great trigonometrical surveys, and for this reason such surveys as, for example, the primary triangulation of the British Isles are commonly called geodetic. In considering the density and attraction of the earth, gravity and isostasy (see special articles on these subjects) are naturally included. Geodesy is largely a mathematical outcome of survey operations. No eminent surveyor can be ignorant of geodesy, nor can there be any eminent geodesist who does not partially understand the work of the surveyor.

That the shape of the earth was spherical was known in Egypt and Greece in the third century B.C. As early as 230 B.C., Eratosthenes actually calculated the dimensions in much the same way as we do to-day. It was not until the seventeenth century A.D., however, that substantial progress was made in the accurate measurement which should form the basis of such calculation. Perhaps the most memorable

achievement in this progress was the conception of a measurement by triangulation due to Willebrord Snell in 1617.

If we assume the form of the earth to be spherical, we can calculate its dimensions in a variety of ways and arrive at a fair approximation. There is, however, only one exact method of arriving at both its form (which is not truly spherical) and its dimensions, and that is by actually measuring arcs on the earth (preferably along meridians), and by determining by astronomical observation the latitude of the ends of these arcs. Early in the eighteenth century a start was made in France in arc measurement. Towards the close of that century several national geodetic triangulations were developing, and to-day in Europe, Asia, North America, and Africa we have, through the continual extension of these triangulations, enough actual measurement to guarantee a very close approximation to the truth.

The linear geodetic measurements necessary for arc determination are given in terms of some standard of length. Thus distances in the geodetic triangulation of Great Britain are known in terms of a foot of the Ordnance Survey 10-foot standard bar. Of greater geodetic importance, however, are the standard yard and the international metre. Both are defined as the distance between two marks on a metal bar at a stated temperature. The most recent comparison between these two standards (in 1896) gives the following relationship: 1 yard = 0.9143992 metre.

The subsequent geodetic operations consist of a base measurement, a triangulation, and astronomical determinations of latitude and azimuth. Base measurement in the eighteenth and nineteenth centuries was carried out with copies of some national standard of length. As these copies were metallic and possessed marked coefficients of expansion, the greatest care was necessary in order to gauge their exact length at the moment of measurement. Colby's compensating bars, designed to eliminate this factor, were used for the later English bases. Modern practice is to use tapes or wires of invar (36 per cent nickel steel), which has an extremely small coefficient of expansion (about 0.000003 of its length per degree Fahrenheit), and the lengths of bases of from 10 to 15 miles are determined with probable error of measurement of one part in one or two million.

For the triangulation, theodolites of 10 inches to 12 inches diameter are used. As a general rule the length of a side of a principal triangle is of the order of 40 miles, and observations are made upon lamps by night, or upon heliostats by day. In modern geodetic triangulations the sum of the three observed angles of a triangle

will be within 1 second of the truth. When the field-work has been completed, the whole network is subjected to a mathematical analysis or adjustment, so as to ensure that the length of any side, calculated through the triangulation, is the same from every base which may have been used in the adjustment, and by every possible path through the triangulation.

The astronomical observations for latitude are made with the theodolite, the zenith sector, or the *astrolabe à prismes*. It would be comparatively easy to determine the latitude within a few feet were it not for what is known as local attraction. Mountain masses and local variations in the density of the earth account for this local attraction, and the errors in latitude determination which result from its influence on the plumb-bob are generally in terms of several seconds of arc, or hundreds of feet. It is obvious, then, that latitude determinations must be made at as many of the stations of the triangulation as possible, in order to secure the best mean value.

The two most important, and most recent, determinations of the figure of the earth are as follows:—

Name.	Date.	Semi-axis Major in Metres.	I Compression
Helmert	1906	6,378,200	208.3
Hayford	1911	6,378,388	296.96

If the earth were a homogeneous sphere at rest, the force of gravity would be the same for all surface points. As it is, however, the earth's rotation and its spheroidal form cause an alteration in the force of gravity, the magnitude of which depends upon the latitude and the height above mean sea-level. This alteration in the force of gravity can be measured by counting the vibrations of a pendulum. In order to measure the force of gravity at any one place, it is a necessary preliminary to determine the length of the pendulum itself, and in practice it is not possible to do so with the necessary accuracy. Accurate relative determinations may be made, however, by comparing the number of vibrations at any two places, and if the latitude of one and the ellipticity of the earth be known, the latitude of the other may be deduced; or the ellipticity may be deduced if both latitudes be known. Pendulum or gravity surveys give us, then, a second exact method of computing the form (though not the dimensions) of the

earth. Clairaut's theorem, upon which such computations are based, is as follows:—

$$p = P[1 + (\frac{5m}{2} - e) \sin^2 \lambda],$$

where p is the length of a seconds pendulum at latitude λ ;

P is the length of a seconds pendulum at the equator;

m is the ratio of centrifugal force at the equator to gravity;

e is the ellipticity of the earth.

The effect of local attraction, which has already been discussed, may be actually measured by determining the position of any point by triangulation, and by comparing the result with its astronomically determined latitude. If we now compute the resulting force, due to the attraction of topographical features, and tending to pull the plumb-bob out of the normal, and compare it with the attraction of the earth as a whole, we have a means of computing the earth's density. Unfortunately, there must always be an element of uncertainty in assessing the attraction exerted by any one feature. The torsion balance has also been used for comparing the attraction of the earth as a whole with that of lead weights. It must be admitted that there still remains a margin of doubt as to the mean density of the earth, but it may be taken as very closely equal to 5.5 times that of water.

In considering the figure of the earth, it is natural also to consider the size and importance of deviations from that figure. Under this heading come such questions as the relative movements of land and sea, and the determination of mean sea-level. These matters will be referred to under other headings, e.g. *Tides*, but the operations of levelling (see *Levelling*) upon which such investigations largely rest are usually described as geodetic.

The initial step in such a levelling is to determine the datum to which it shall be referred. In cases where mean sea-level is to be datum, exact values must be obtained from tidal stations over a long period of years, in order to assess the effects of long-period fluctuations. The next step is to ensure by careful construction the stability of the controlling bench-marks.

The levelling itself is carried out with instruments and methods of special precision, but differing from those of ordinary engineering practice only in degree. They may be studied in C. Lallemand's book *Nivellement de Haute Précision*, and in vol. xix of the account of the G. T. Survey of India.

The International Geodetic Association has

decided that levelling should not be regarded as geodetic (or of high precision), unless all the lines are levelled twice (once in each direction), and show probable accidental and systematic errors of less than 1 mm. and '3 mm. respectively per kilometre.—BIBLIOGRAPHY: A. R. Clarke, *Geodesy*; G. L. Hosmer, *Geodesy*; M. Merriman, *Precise Surveying and Geodesy*; *Principal Triangulation of Great Britain and Ireland* (London, 1858); *Account of the Operations of the Great Trigonometrical Survey of India*; *Report on the Geodetic Survey of South Africa*; *Reports of the Superintendent of the Coast and Geodetic Survey* (Washington).

Geoffrey of Monmouth (called also *Geoffrey ap Arthur*), an ecclesiastic and historian of the twelfth century. He sprang from the Norman settlers in Wales; became Archdeacon of Monmouth, whence he was, in 1152, raised to the bishopric of St. Asaph. He died in 1154. His so-called *History of the Britons* (*Historia Britonum*), in circulation by 1139, is now known to consist mainly of fiction, but the writer professes that it was taken from an ancient book in the Breton tongue, discovered by Walter, Archdeacon of Oxford. It contains a spurious account of the Kings of Britain from the time of the fabulous Brutus, or Brute, the Trojan, to the death of Cadwallader, King of Wessex, in 688. It was soon translated into French, English, and Welsh, and became a great source of romance to the writers of successive generations.

Geoffroy St. Hilaire (zhof-rwā san tē-lār), Étienne, French naturalist, born in 1772, died in 1844. He was educated at the colleges of Navarre and Lenoire, and became a favourite pupil of Hailly. At the age of twenty-one he obtained the chair of zoology in the Parisian Jardin des Plantes. As a member of the Egyptian expedition in 1798 he founded the Institute of Cairo, and returned about the end of 1801 with a rich collection of zoological specimens. In 1807 he was made a member of the Institute, and in 1809 professor of zoology at the Faculty of Sciences. He devoted himself especially to the philosophy of natural history. The fundamental idea brought conspicuously forward in all his works is, that in the organization of animals there is only one general plan, one original type, which is modified in particular points so as to present differences of genera. This view met with strong opposition from Cuvier. Among his principal works are: *Sur le principe de l'unité de composition organique*; *Philosophie anatomique*; *Histoire naturelle des mammifères*, written in conjunction with Cuvier; *Notions de philosophie naturelle* (1838).

Geoffroy St. Hilaire, Isidore, physiologist and naturalist, son of the preceding, was born at Paris 1805, died 1861. He devoted himself

to natural history, and in 1824 was appointed assistant to his father at the Jardin des Plantes. He was elected to the Academy of Sciences in 1833, and afterwards became successively inspector-general of the university, member of the Council of Public Instruction, and professor of zoology at the Academy of Sciences. One of his chief works, *Histoire générale et particulière des anomalies de l'organisation chez l'homme et les animaux*, added valuable confirmation to the theories of his father. He founded the Acclimatization Society of Paris.

Geoglossum, popularly known as earth-tongues, is the name given to a genus of ascomycetous fungi of the family Helvellaceae.

Geognosy (Gr. *gē*, earth, and *gnōsis*, knowledge), a term which originated among the German mineralogists, and is nearly synonymous with *geology*. It is the science of the substances which compose the earth or its crust, their structure, position, relative situation, and properties.

Geographical Societies are associations formed with the view of obtaining and disseminating geographical knowledge. In point of seniority the first of these associations is the Société de Géographie of Paris, founded in 1821, whose magazine, the *Bulletin de la Société de Géographie*, commenced in 1822. The Prussian Gesellschaft für Erdkunde held its first sittings in Berlin in 1828. The more important results of its investigations are published yearly in the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*. The Royal Geographical Society, established in London in 1830, has a capital of over £47,000, and large sums are devoted annually to aid the cause of geographical research, or spent in recognition of services to geography. The *Geographical Journal* is published by it monthly. The Royal Scottish Geographical Society, founded in 1884, also publishes a monthly magazine. The Russian Geographical Society, founded at St. Petersburg (Petrograd) in 1845, has greatly extended our knowledge of Asia, and especially Asiatic Russia. The American Geographical Society was founded at New York in 1852, and publishes an interesting journal. Italy has her Società Geografica, founded at Florence in 1867.

Geography. I. INTRODUCTION.—*Definition and Development of Geography.*—Geography is the description of the earth in its relation to man. It is based on knowledge of the surface of the earth as discovered by exploration, and interpreted by various sciences, such as meteorology for the weather, zoology and botany for animal- and plant-life, anthropology for the human race, and geology for the structure of the earth and the development of its surface features. Geography is dependent on astronomical methods for the determination of positions and the mathematical

basis of maps, and is closely associated with history in the study of social conditions. Geography uses the results of each of these departments of knowledge for the advance of its own special subject—the relation of man to his environment.

Geography began in prehistoric times, when men were forced to wander far afield in quest of food and fuel, and to open trade routes to distant areas for other essential materials. Prehistoric traders from the Mediterranean crossed Central Europe to the Southern Baltic in quest of amber, sailed to the British Isles for tin, travelled overland to China for silk, and to East Africa, and probably also Southern India, for gold. The geographers of Egypt and Greece thereby acquired a general knowledge of remote parts of Europe, Asia, and Africa. The Roman Empire advanced the development of the countries accessible by land from the Eastern Mediterranean, but did not greatly extend the area of the known world. The Vikings of North-Western Europe found their way to North America in the tenth century; but their discovery was forgotten, for Europe was unable to use it until the development of modern navigation in the fifteenth century. America was rediscovered in 1492, and its exploitation then begun. Spain acquired Central and Western South America; Brazil was developed by Portugal; France and Britain colonized North America; and the outlines of American geography were gradually traced as the two continents fell under European control.

Knowledge of the geography of Africa, with the exception of Egypt and of the Mediterranean lands, was delayed owing to the special difficulty of travel in the interior of the continent. The opening of the route to India around South Africa by Vasco da Gama in 1498 led to Portuguese settlements at the Cape and along both coasts. Early Portuguese missions penetrated the interior in all directions, but left there comparatively few permanent marks of their explorations. Dutch, British, and Portuguese colonies were later used as bases for the investigation of Central Africa, in which the modern interest was inspired by Livingstone's great journey of 1853–6, and the mystery regarding the sources of the Nile. The partition of Africa among the European powers, and opportunity for detailed geographical study, resulted from Stanley's expedition across equatorial Africa and down the Congo (1874–7), and the consequent establishment of the Congo Free State (1885).

Australia and New Zealand, though known to early Malay sailors and South Sea Islanders, were revealed to Europe by the work of the Dutch seamen Hartog and Tasman. The colonization of Australia was undertaken largely

owing to the faith in its future held by Sir Joseph Banks, after his voyage with Captain Cook along its eastern coast in 1770.

The exploration of the Arctic Regions was started in the effort to find northern routes to India. The search for a passage north of Asia led to the discovery of Spitsbergen, which was used as the base of the Arctic whale-fishery during the seventeenth century. The effort to force the north-west passage to the Pacific led to the exploration of Greenland and of the archipelago north of America, and to the development of methods of travel adapted to Polar Regions. The Antarctic continent was delimited by Captain Cook, and is still the least known of the great land areas of the earth; recent exploration has shown its unity as a great ice-clad land.

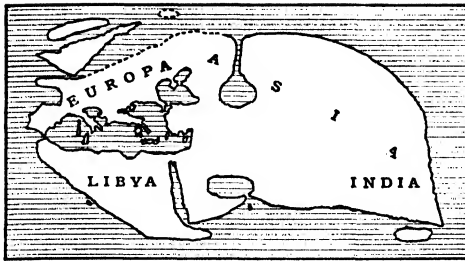
The scientific interpretation of geography began in Egypt and Greece from the study of the seasons, and the necessity of fixing boundaries between different districts and estates. The ancient Egyptians, in the time of Rameses II (1300 B.C.), made a careful land survey, which was used by Eratosthenes of Cyrene (276–196 B.C.) for the measurement of the distance between Alexandria and Syene, and from that result he determined the size of the earth.

Astronomical geography was greatly advanced in Egypt by Ptolemy (A.D. 150), of whose famous map of the world the oldest-known copy dates from the twelfth or thirteenth century. The Arabs, inspired by Al Mamun, Caliph of Baghdad, in 827 measured an arc of the meridian and improved cartography; their charts of the Indian Ocean were superior to those of the Mediterranean, as was recognized by Vasco da Gama from those used by his Indian pilot. Modern cartography, based on scientific projections, was founded in the fifteenth century, and a century later, in 1569, Mercator prepared a map of the world on his useful projection.

Oceanography was established by the voyage of H.M.S. *Challenger* (1872–5), which by extensive systematic soundings, deep-sea temperature records and dredgings, analyses of sea-water, and collection of deep-sea organisms and deposits revealed the depths and general conditions of the ocean basins.

II. THE SURFACE OF THE EARTH

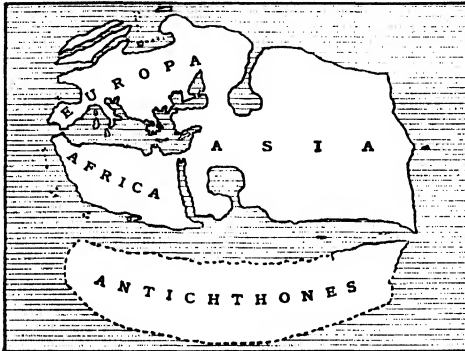
The surface of the earth consists of a rocky crust, of which the raised portions form the lands, while the intervening depressions are occupied by the seas. The earth as the home of man is dependent on the arrangement of these elevations and depressions. The major elevations are the continents; the major depressions are the ocean basins. Minor geographical fea-



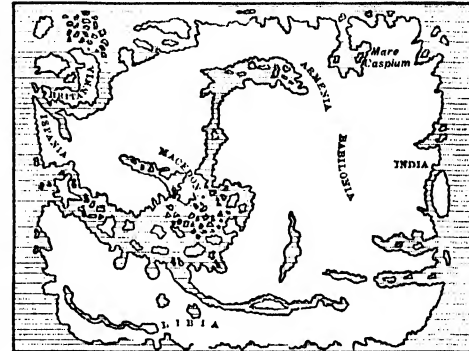
ERATOSTHENES, 3rd. Century B.C.



PTOLEMY, 2nd. Century B.C.



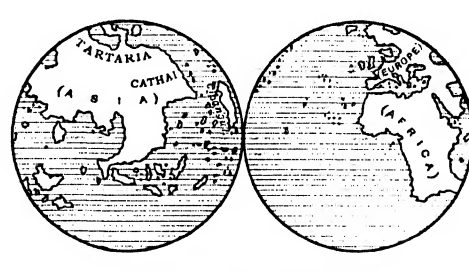
POMPONIIUS MELA, 1st. Century B.C.



ANGLO-SAXON MAP, 9th. Century A.D.



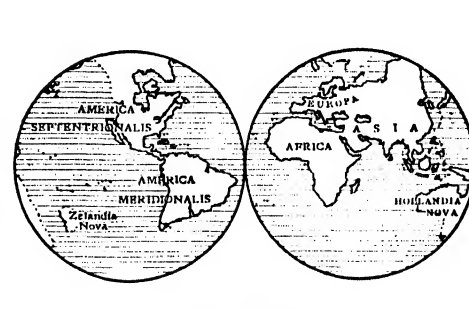
THE HEREFORD MAP, circa 1280



BEHAIM'S GLOBE, 1492



MERCATOR, 1569



BLAEU, 1664

tures, including both hollows and ridges, have been largely excavated by various geographical agents. Rivers and glaciers wear out or enlarge valleys; the wind and the sea abrade the surface of the land into plains; the formation of beds of clay and sand over the floors of valleys, of lakes, or of the sea produces plains of deposition. Many hills and mountains are residual masses left between valleys excavated by erosion; others are piles of material discharged by volcanic eruptions. Some valleys, basins, and mountains are, however, due directly to earth movements, in areas that have been lowered or raised by fold or fracture.

LAND-FORMS.—The variations in level of the earth's surface give rise to geographical structures known as the land-forms, of which there are two main categories. The positive land-forms are the solid features in the face of the earth, including plains, plateaus, and mountains; the negative land-forms are the spaces between the positive land-forms, and are classified into valleys and basins.

i. *The Positive Land-forms.*—(a) *Plains* are widespread areas with an even surface and situated at a low level in relation to the surrounding country. There are four chief varieties of plains: coastal-plains, those due to the uplift of the sea-floor; river-plains, those formed by the deposition of material by rivers along their course; planes of marine denudation, those due to the cutting back of the coast by the sea; and pene-planes, those due to the levelling of a country by rivers and wind.

(b) *Plateaus* are flat-topped areas which are well raised above the surrounding country. The surface of a plateau in countries with a moderate rainfall is gradually destroyed, for, as streams cut into it, the plateau is dissected into an irregular or old plateau; later, when the valleys have been deepened and widened, the plateau is converted into a tract of highlands, in which the essential structure is indicated only by the fact that the majority of the residual ridges and peaks reach the original surface and none rise above it.

(c) *Mountains and hills* are raised areas which culminate in well-marked summits or crests. Some of them are due to parts of the earth's crust having been crumpled into folded bands by lateral pressure, as a cloth is wrinkled into folds when pushed across a table. Fold-mountains occur as long, relatively narrow ridges, of which the unit is the mountain range. A series of ranges due to a common origin form a mountain chain, such as the Alps or Pyrenees. A connected series of chains formed about the same date and by a common cause forms a mountain system. Block-mountains are blocks or slabs of the earth's crust which have been up-

lifted, or which have been left upraised by the subsidence of adjacent areas. A mountain mass thus formed is known as a horst. Volcanic mountains are accumulations of lava or tuff discharged by volcanic eruptions. Residual mountains are those left upstanding owing to the removal of the adjacent land by denudation.

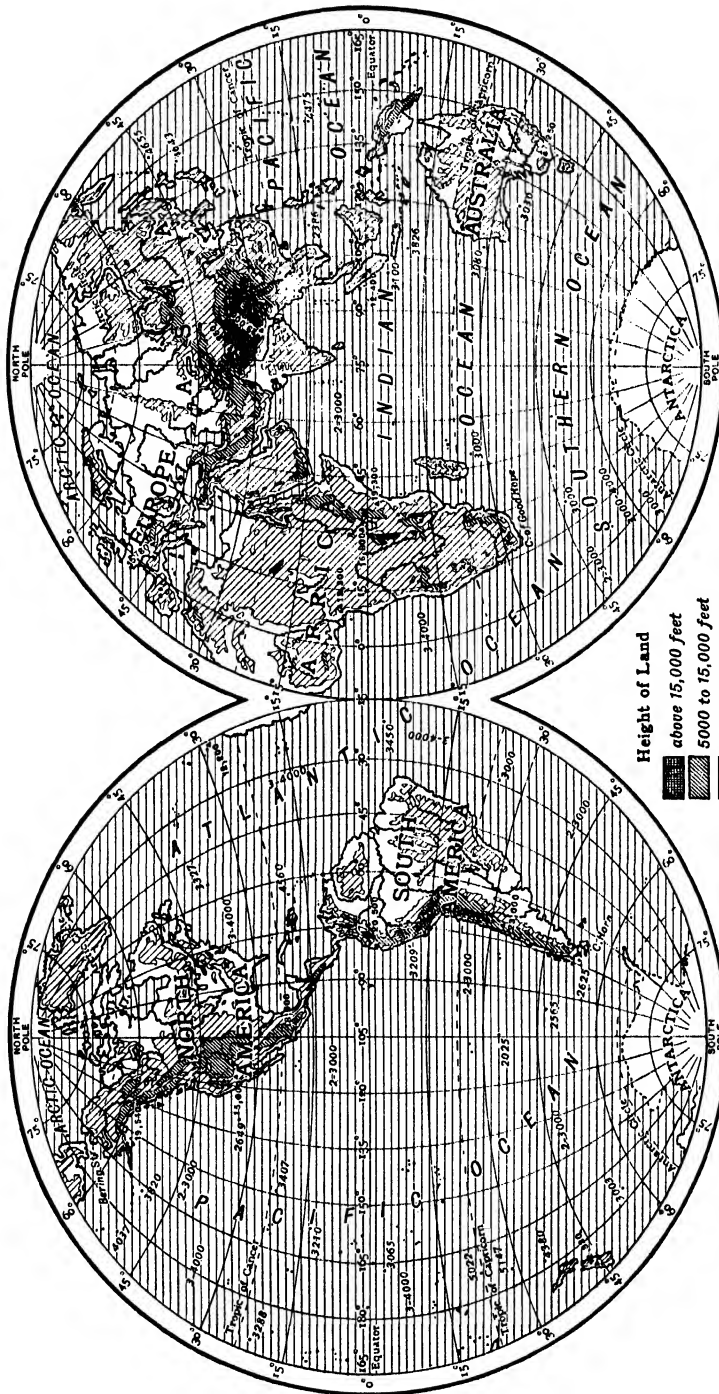
ii. *Negative Land-forms.*—They include two classes—basins which are wide, and valleys which are narrow, in comparison to their length. The greatest of the basins are those occupied by the oceans. Some smaller but still extensive basins are occupied by the enclosed seas. Basins of which the floor consists of land are chief centres of population.

Valleys vary from great oceanic troughs, like that of the Atlantic, to wide old river valleys, and to the narrow young valleys known as gorges and canyons. The majority of the minor valleys and basins have been made by excavation. Basins are often due to a valley formed by excavation having been divided by the raising of a barrier across it by a 'warping' or rumpling of the surface. Some valleys and basins are due to the direct subsidence of their floors forming sunk-lands in the case of basins, and rift-valleys in the case of valleys. Small basins due to the subsidence of their floors are known as caldrons.

The floor of the sea is diversified by variations in level, similar in kind to those on the surface of land. The negative forms on the sea-floor are the 'depression', which includes basins, troughs, trenches (i.e. small troughs), and 'deeps' (i.e. the deepest part of a depression). The positive forms are the 'shelf', a submerged coastal plain which slopes gradually from the level of low tide to the depth of from 300 to 600 feet; the 'rise', a large, gently-rising mound; the 'ridge', which is long and narrow; the 'plateau', which is about as long as it is broad; and the 'height', a peak-like summit.

Coasts may be long and straight where the action of the tide has filled up the bays and cut back the headlands. Coasts are deeply indented where the land has sunk, so that the sea has flooded the former valleys. A drowned coast is characterized by having many irregular arms of the sea which run far inland, by projecting in long peninsulas and headlands with curved shores, and by a fringe or festoon of islands. Arms of the sea on drowned coasts are known as 'rias', from those of North-Western Spain; the long bays, such as Bantry Bay, in South-Western Ireland are typical rias. On a drowned fractured coast the sea extends inland in long, narrow, canal-like channels between high straight walls, with angular bends and branches; such arms of the sea are known as 'fjords'.

THE WORLD: OROGRAPHICAL



A. The Lands

1. *The Continent of Europe.*—Europe is the most complex of the continents. Its eastern and western divisions are strikingly different in structure and geographical character. Russia is an extension of the continental mass of Asia, while Western Europe consists of a series of peninsulas of which the axial peninsula includes France and Germany; secondary peninsulas project southward as the Balkans, Italy, Spain, and Portugal, and northward as Denmark. The peninsula of Scandinavia, which was formerly connected to Germany, is now united to the continent only to the north-east. The British Isles were a peninsula until isolated by the formation of the English Channel.

The Peninsular Axis of Europe lies along the mountains of the Alpine System, of which the central constituent is the Alps; extensions of these mountains continue westward as the Pyrenees, and eastward through the Carpathians to the Balkan Mountains and the Caucasus. This mountain axis of the continent includes its highest summits, Mt. Blanc (15,781 feet) in France, and Elburz, in the Caucasus (18,500 feet). The course of the mountain axis is sinuous owing to the resistance of old blocks of hard rocks, which form Brittany and the Central Plateau of France, the Black Forest, and other highlands of Southern Germany, Czecho-Slovakia, and the large area of ancient rocks known as the Russian Platform in South-Western Russia. Southward from the Alps projects a series of mountain loops, which include the Sierra Nevada of Southern Spain, the Atlas Mountains of North-Western Africa, the Apennines of Italy, and the mountains of the Western Balkans, of Greece, and of Asia Minor. North of the Alpine System and of the ancient plateaus beside it lies the European Plain, which extends from Eastern England across Holland, Denmark, and Germany, to the east of which it widens out to include most of Russia. South of the Alps sunkenlands have been formed by the subsidence of their floors; they include the Hungarian Plain within the loop of the Carpathians and the mountains of Transylvania, the basins of the Mediterranean, the Adriatic Sea, the Ægean Sea, the Black Sea, and the Caspian. North of the European Plain are the remains of an ancient plateau which now includes Scandinavia, Finland, and Lapland; it was formerly continuous with the Scottish Highlands and North-Western Ireland, and doubtless once extended across the Atlantic to North America. The western coasts of Scandinavia and Scotland have been fractured, and are indented by numerous fiords.

As the main slopes of Europe have been deter-

mined by the east to west course of the Alpine System, most of the larger rivers flow northward or north-westward; this course holds from the Seine, which discharges into the English Channel, to the Dvina, which flows across Northern Russia into the White Sea. In Russia the main watershed crosses the Valdai Hills, and lies farther north than in Western Europe; so its longest rivers flow southward, such as the Volga, Don, and the Dnieper. The most important European river flowing from west to east is the Danube; it rises in Southern Germany; it cuts twice through the line of the Alpine System, firstly near Vienna, and secondly at the Iron Gates of the Danube in Western Roumania; and it discharges to the Black Sea.

The lakes of Europe mostly occupy narrow basins in the Alps, and in the highlands of Scandinavia and Scotland; the largest of the lakes lie in shallow depressions in the plains, such as Lakes Ladoga and Onega in Russia, Lake Balaton in Hungary, and Lough Neagh in Ireland.

The political division of Europe has been largely controlled by its physical structure. Holland, Denmark, Northern Germany, and most of Russia belong to the great European Plain. To the north of it the peninsula of Scandinavia is a fragment of the ancient land of which the Scottish Highlands are an outlier; and the fact that Finland is structurally part of the same area explains the differences which kept it so aloof while it was part of the Russian Empire, and have led to its restoration as an independent state. To the south of the European Plain Switzerland, Southern Germany, and Austria lie beside the Carpathian-Alpine Mountains, along which the Alpine people penetrated Central Europe. Hungary, consisting mainly of a great plain within the loop of the Carpathians and Alps of Transylvania, has maintained its political and ethnographic distinctness, as the country was especially attractive to the Magyars, who established there the most western permanent settlement of the Mongols in Europe.

France has the most advantageous commercial position in Europe, for its ports are open both through the Atlantic to America and through the Mediterranean to the East; it has also the advantage of a varied population, due to the advance of Alpine people from Switzerland, the spread of Celts along the western coast, and the settlement of Normans attracted by the superiority of the soils and climate of Normandy to those of their homeland in Scandinavia. These different races have been welded into a nation owing to the unity of the country between the Alps and Pyrenees to the south-east and south, the Atlantic and English Channel to the west and north, and the hills to the north-east, which

formed a rampart against invaders advancing westward across the European Plain.

Italy, also a country inhabited by people belonging to several races, has achieved national unity owing to the physical unity given to the country by its mountain backbone, the Apennines. The Balkan Peninsula, on the other hand, has developed as the home of a series of small nationalities in accordance with its irregular structure; it is divided into the states of Roumania, Yugo-Slavia, Albania, Greece, Bulgaria, and Turkey, which retains a footing in Europe, though given only nominal control of its capital, Constantinople.

Spain consists mainly of a high rugged plateau between the fold-mountains of the Pyrenees on the north and of the Sierra Nevada on the south. Its richest lands are on the marginal slopes to the sea. Portugal has remained racially and politically distinct from Spain owing to the differences between the central plateau, which is held by Spain, and the western slope, which was occupied by Celts during their migration coastwise from the Mediterranean to North-Western Europe.

2. The British Isles.—The British Isles represent a former prolongation of North-Western Europe, from the mainland of which they have been detached in recent geological times. They consist of four chief geographical constituents, which give the islands their great variety in surface features and in agricultural and mineral resources. The oldest geographical constituent forms the Scottish Highlands and the hilly country of Donegal in North-Western Ireland. It is composed of the oldest rocks present in any considerable extent in the British Isles; it was formerly part of the ancient land which comprised also Scandinavia and Finland, and doubtless extended westward across the Atlantic and included North-Eastern America. The Scottish Highlands were upraised as a plateau, which has now been dissected into an irregular series of hills and valleys; their mountains include Ben Nevis, 4406 feet high, the highest summit in the British Isles, and within their valleys are the longest and deepest of the British lakes. The western coast is deeply indented by a series of fiords known as 'lochs'. Most of this country stands at a high level; the ground is rocky, the climate cold and wet, and no economic minerals occur in useful quantities. It is accordingly the most sparsely peopled part of the British Isles. The population in the highland counties is still declining, as they cannot provide such easy conditions of life as the industrial areas and the southern agricultural districts.

The Scottish Highlands are bounded to the south by a fracture known as the Highland Boundary Fault, which can be traced all across

Scotland and into North Ireland. Between this fault and a parallel fault to the south, a strip of country about 50 miles wide has been lowered, and its beds of coal, oil-shale, iron-ore, and fire-clay have been thereby protected and preserved. They are now being worked by mines in the Midland Valley of Scotland. This valley, owing to its rich mineral resources and its commercial outlet through the Clyde, is the most densely populated and wealthiest part of Scotland.

South of the Midland Valley are the Southern Uplands, an area of down-like hills mostly occupied by sheep-farms, with arable land in the valleys; this type of country extends across the Scottish border to the Cheviot Hills in Northumberland, and along the Pennine Hills into Central England, and it has a western outlier in the mountains of the Lake District. The lower country on either side of the Pennines contains four important coal-fields: that of Northumberland and Durham is along the eastern coast; that of Cumberland is beside and partly under the Irish Sea; farther south, to the west of the Pennines, is the coal-field of South Lancashire; and to the east is the coal-field of South Yorkshire, Derbyshire, and Nottingham. The abundance of coal in these northern coal-fields has so greatly aided the industries which were founded in the dales of Yorkshire and Lancashire on water-power, that the northern counties include some of the most active manufacturing districts and most densely populated parts of the British Isles.

South of the Pennines lies the Midland Plain, under which are the coal-fields that enabled Birmingham to become the manufacturing metropolis of the Midlands, and converted South Staffordshire into the Black Country. Great chemical industries have developed on the salt deposits of Cheshire. To the east and south of the Midland Plain the country is traversed by an approximately parallel series of hills and valleys, with a general trend from south-west to north-east, along the geographical grain of the country. The hills are situated where the harder layers of rock have been left upstanding when the valleys were excavated, mainly by river action, along the softer bands. Parts of the hill country, such as the Chalk Downs, are used for sheep, but South-Eastern England, owing to its moderate elevation and warm, dry, sunny climate, includes some of the richest agricultural areas in the British Isles. The Thames Valley and the hills to the south of it trend mainly east and west, owing to the structure of Southern England being determined by the course of a series of rocks which rise to the surface in Devon and Cornwall and there form extensive moorlands. These rocks disappear eastward under younger rocks, which they underlie as a platform at a

depth of more than 1000 feet; they reappear at the surface in Belgium, and also outcrop in South-Western Ireland and Northern France. They are part of an ancient mountain chain, the Armorican Mountains, which can be traced from Central Germany to the hills of Cork and Kerry.

Their economic value depends partly on their coal-fields, including those of South Wales, the Forest of Dean, Bristol, and the coal-field of Eastern Kent. Wales lies mostly to the north of these hills, but the South Wales coal-field trends east and west in accordance with the grain of the Armorican System. This coal-field is especially important from its yield of smokeless anthracitic coal. The rest of Wales consists of hard rocks dissected into mountains and valleys, and mainly used as pastoral moorland.

Ireland consists in the main of a central plain of limestone, surrounded by a broken rim of hard rocks which resist denudation and remain as hills; they form the Mourne Mountains, the hills of Wexford and Wicklow, of Cork and Kerry, of Connaught and Donegal. The Antrim Plateau, in the north-eastern corner of Ireland, is built up of lava flows.

Within this mountain rim is the Central Plain of Ireland, mostly a tract of limestone. The chief river, the Shannon, flows across this plain, on the floor of which are many lakes, including Lough Neagh, the largest in the British Isles.

3. *The Continent of Asia*.—Asia is the largest of the continents; its area, over 17 million sq. miles, contains one-third of the land and more than half the people of the world. It is traversed from east to west by a great mountain belt, the southern border of which encloses the highest mountains of the world, of which the traditional heights are Mt. Everest (29,002 feet) and Kanchenjunga (28,140 feet), though both are now regarded as somewhat higher than those figures. The Himalayan Chain was formed by earth movements at the same period, and due to the same cause, as those which made the Alpine System of Europe. This mountain band separates the northern plains of Asia, which are continuous with the great European Plain, from a southern series of valleys and basins which are an extension of the Mediterranean. These valleys and basins are bounded to the south by plateaus of ancient rocks in positions corresponding to that of Africa to Europe.

The northern plains extend from the Ural Mountains and the Caspian across Turkestan and Siberia, gradually narrowing eastward to the peninsula beside Behring Strait. They sink 84 feet below sea-level beside the Caspian, and rise 1700 feet above it in the Siberian Steppes. They have a long, gentle, northward slope, down which great rivers flow to the Arctic Ocean; the northern part of these plains, the tundras, are

sparsely peopled, since they are frozen in winter and their soils are water-logged in summer. Southern Siberia includes vast areas of fertile land, has a good climate, and is already of great pastoral and agricultural value. The use that could be made of Siberia and of its extensive forests would be greatly increased if a route that would be practicable every summer could be found across the Arctic Ocean from the Siberian rivers to the markets of Western Europe. The older rocks in the southern part of the steppes are often rich in minerals, and especially gold.

The mountain backbone of Asia extends from the Caucasus to Behring Straits. Its greatest width consists of the plateaus of Turkestan, Mongolia, and Tibet. The southern margin of the plateau belt is formed of fold-mountains which are the continuation of the Alpine System of Europe; they extend from the Caucasus through the Elburz Mountains of Northern Persia, the Hindu Kush, and the Himalaya; their farther eastward continuation is uncertain. According to one view, the north-eastward extension of the Himalayan line forms the mountain front that separates Tibet and Mongolia from China, and continues through the Great Kingan Mountains of Northern China and the Yablonoi Mountains to Behring Strait. According to another view, these mountains are the dissected eastern margin of the central plateau of Asia, and the continuation of the Himalayan line is through the mountains of Western Burma and the Andaman Islands to Sumatra, and farther east its segments form the southern boundary of the Eastern Archipelago as far as New Guinea. The islands of that archipelago are the fragments of a disrupted ancient land which lay to the north of the fold-mountain belt.

The highlands of Tibet and Mongolia, the largest high plateau in the world, owing to their great elevation and distance from the sea, have a severe winter climate and low rain-fall, and are one of the most extensive of the desert areas.

The fold-mountains of the Himalayan System are bounded to the south by a series of valleys and basins formed by subsidence. Asia Minor and Persia on the north are separated from Arabia by the long depression through which flow the Rivers Euphrates and Tigris. The north-western part of this depression forms the plains of Mesopotamia; the south-eastern part is occupied by the Persian Gulf. A corresponding depression crosses India from Sind to Eastern Bengal; it is known as the Indo-Gangetic Plain, as its western portion includes the lower valley of the Indus, and most of the eastern belongs to the Ganges Valley. South of the Mesopotamian and Indo-Gangetic Valleys occur the plateaus of Arabia and of the peninsular portion of India, both of which consist of very ancient

rocks with a high western front and a long eastward slope. In spite of these resemblances between Arabia and Southern India, their geographical development is fundamentally different, since the peninsula of India is well watered by the heavy rainfall of the monsoons, while Arabia has an arid climate, owing to its position on the desert belt that extends across the Old World from the Sahara into Central Asia.

Arabia and India were delimited by the subsidences which formed the Arabian Sea and the Bay of Bengal. Corresponding subsidences formed the China Sea, which separates the plateau of ancient rocks in South-Eastern China from the Philippine Islands and the Eastern Archipelago; also the Sea of Japan, that lies between the mainland and the Japanese Archipelago, and the Sea of Okhotsk to the west of the peninsula of Kamchatka.

The arrangement of the main valleys and of the river system of Asia has been determined by the uplifts which formed its main mountain system. North of the mountain belt the Obi, Yenisei, and Lena Rivers flow across Siberia to the Arctic Ocean; others flow through Turkestan to the Sea of Aral, where their waters are lost by evaporation. In the valleys south of the mountain belt flow the Euphrates, Tigris, Indus, and Ganges; and owing to the tilt of the peninsula of India its rivers rise near the western coast and flow across the peninsula to the Bay of Bengal. The plateau of Tibet and Mongolia gives rise to the Hoang-ho and Yangtze-kiang, which flow eastwards across China to the Pacific. South-Eastern Tibet is drained by four great rivers, the Tsing-po, the Salwin, Mekong, and upper part of the Yangtze-kiang. The Yangtze flows for some distance parallel and near to the Mekong and the Salwin; it suddenly turns eastward and reaches the Yellow Sea at Shanghai. The Mekong crosses French Indo-China and discharges into the China Sea in Cambodia; the Salwin reaches the Bay of Bengal through the Gulf of Martaban; the Tsing-po cuts abruptly across the eastern Himalaya and continues as the Brahmaputra to the Bay of Bengal.

Most of Asia is politically dependent on Europe. The plains of Siberia and of Turkestan fell under the dominion of Russia, which, by the Trans-Siberian Railway, opened the country and gave its agricultural and dairy produce access to the European markets. The hold of Turkey over South-Western Asia has been broken by the European War, and much of Asia Minor, Arabia, and Mesopotamia is now under French, Italian, Greek, and British control. Great Britain supplies expert advisers for the several departments of the Persian administration, and provides officers for a police and frontier force. India, isolated from the rest of Asia by the

Himalaya, by the barren mountains west of the Indus, and by the forest-clad mountains of Northern Burma, is one of the richest and most productive of Asiatic countries; its wealth has led to its repeated conquest. It is now the most populous dominion of the British Empire. Most of South-Eastern Asia has been annexed by the European powers: Burma and part of the Malay Peninsula are British; Tonkin, Annam, and Cochinchina are French; most of the Eastern Archipelago, including Sumatra, Java, the larger part of Borneo, Celebes, and Western New Guinea, is Dutch. The independent countries are China, Japan, Afghanistan, Tibet, Angora, and Siam. China, the oldest of existing states, was formerly one united monarchy, but since the revolution in 1911 it has lost part of its outlying provinces, and is now a series of semi-independent republics and provinces. Japan, in addition to the Japanese Archipelago, rules Korea, Manchuria, and Formosa, most of Saghalien, and the Caroline and Pelew Isles. Owing to its efficient fleet and widening control over the islands of the Western Pacific, Japan has become the most powerful of Asiatic states.

Siam, including the northern part of the Malay Peninsula, is a kingdom of which the independence is guaranteed by an agreement between France and Britain. Tibet was formerly part of the Chinese Empire, but declared its independence after the Chinese revolution of 1911; it is still under Chinese suzerainty.

4. *The Continent of Africa.*—Africa, the home of the negro race, is structurally the simplest of the continents. It consists mainly of an ancient plateau which has been affected by recent mountain folding only along its north-western margin, where movements of the same date as those that formed the Alps raised the Atlas Mountains across Morocco, Algeria, and Tunis. Cape Colony is traversed by mountains trending east and west which were due to folds of a much earlier period than those of the Atlas. These South African folds thrust the southern part of Cape Colony against the African plateau. Between these two remote lines of fold-mountains Africa stands as a vast block, the surface of which rises and falls in broad undulations due to sagging along the chief valleys. It has been cut off to east and west by the subsidences that formed the Atlantic and Indian Oceans.

South of the Atlas Mountains lies a broad, low valley, which contains numerous shallow salt-lakes known as Shotts; it reaches the Mediterranean in the Gulf of Sirtis, east of which it continues to Egypt to the south of the plateau of Cyrenaica. South of this valley the country rises to the desert plateaus of the Sahara and Libya. Farther south the rainfall is heavier, and the plateau is covered in the equatorial zone

by the dense forests of West Africa and the wide grassy steppes of East Africa.

Most of the mountains on the African plateau are residual, and are due to denudation throughout the geological ages; but the highest individual peaks, those of Kilima Njaro (19,321 feet), Kenya (17,007 feet), and the Cameroons, are extinct volcanoes, or blocks of old rocks tilted by earth movements, such as Ruwenzori (16,815 feet). Many of the best known of African mountains are parts of the dissected front of the plateau.

The four chief rivers of Africa flow over the plateau. The Nile, the only great African river flowing in a meridional direction, has been formed by several distinct basins having been connected by a valley running north and south, roughly parallel to the earth movements which made the Red Sea and the East African coast. The lower Nile receives most of the water with which it irrigates Egypt from the rainfall on the mountains of Abyssinia, for the discharge from the equatorial lakes is mostly lost in the arid plains south of Khartoum. The Niger has an almost loop-shaped course, a series of rivers flowing east or west having been joined by valleys trending north or south, by the chief of which the river reaches the sea. The Congo flows from east to west, and drains the largest basin of Equatorial Africa. It flows eastward over the plateau as a great navigable river until it reaches the western front, down which it rushes in the wild cataracts between Stanley Pool and the sea. The Zambezi, on the other hand, rises behind the western coast and flows eastward; it descends from the plains over the Victoria Falls into the wide, deep valley through which it crosses Rhodesia and Portuguese East Africa to the Indian Ocean.

The lakes of Africa are of two kinds. The great rounded lakes occupy depressions in which the water accumulates until it is lost by evaporation as from Lake Chad, or overflows like the Nile from the Victoria Nyanza. The lakes of the other kind are long, narrow, and lie between high walls. They have often been described as fiord-like. They occupy depressions in the long trough known as the Great Rift Valley. This valley was formed by the subsidence of its floor between parallel fractures. It extends from the Jordan Valley in Palestine through the Red Sea to East Africa, where it includes Lake Rudolf, the Albert Nyanza, Tanganyika, and Lake Nyassa, and ends south of the Zambezi. Tanganyika, the second deepest lake in the world, 4708 feet deep, with its bed 2172 feet below sea-level, is the largest of these lakes, and is one of the sources of the Congo.

Africa is almost entirely under foreign control; with the exception of Abyssinia and Liberia,

the whole continent has been parcelled out amongst the European powers as colonies, protectorates, or dependencies. The political partition of Africa began in the fifteenth and sixteenth centuries with the establishment of settlements on the western coast and in South Africa as naval stations on the route to India. The stations in South Africa were originally Dutch and Portuguese. After the British annexation of Cape Colony and Natal, many of the Dutch settlers migrated inland and founded the Boer republics of the Transvaal and Orange Free State. The Portuguese retain the colony of Mozambique on both sides of the lower Zambezi in East Africa, and also the colony of Angola from the Congo southward to the Cunene River in West Africa. The Portuguese claimed dominion over the whole intervening belt of the continent, but their possession lapsed through non-occupation. The interior north of the British South African colonies was developed as the Protectorate of Rhodesia, which extends northward across the Zambezi to the southern end of Tanganyika. The European dominion over Northern Africa was begun by the French conquest of Algeria, which was followed by annexation of the Mediterranean coast states, from the Atlantic to the Gulf of Sirtis, including Morocco, Algeria, and Tunis. Italy holds the protectorate over Tripoli; Egypt has been an independent kingdom since March, 1922.

The partition of tropical Africa began after Stanley's journey across Africa revealed the conditions of the country and people along the Congo. His action led to the foundation of the Congo Free State (1885), and its ultimate success resulted in a scramble for tropical Africa by the European powers. Germany acquired extensive colonies which have, since 1919, been administered by other powers under mandates from the League of Nations. The former colony of German South-West Africa is attached to the Union of South Africa. Most of the colony of German East Africa is administered by Britain as the Tanganyika Territory; north of it are the two British territories Kenya Colony and the Uganda Protectorate. Attached to Kenya Colony is the Protectorate of Zanzibar, which includes the clove-growing islands of Zanzibar and Pemba, and the East African coast from the Juba to the south of Mombasa. Kenya Colony and the Uganda Protectorate include the northern part of the basin of the Victoria Nyanza, whence they extend northward to the Anglo-Egyptian Sudan, which is continuous with Egypt. The territories under British administration extend, therefore, from Cape Colony to the Mediterranean.

Opposite Aden, on 'the Eastern Horn of Africa', is Somaliland, of which part is British

and the rest Italian. North-west of Somaliland, along the shores of the Red Sea, the Italian colony of Eritrea and the French colony of Jibuti separate the highlands of Abyssinia from the sea. The mountains of Abyssinia form a fortress which is the only strong independent African state.

Most of North-Western Africa is under France; its dominion extends from the French Congo on the south across the Sahara to its Mediterranean colonies on the north, and through the Sahara westward to the Atlantic in Dahomey, Senegambia, and Morocco. The French hinterland forms the inland boundaries of the British colonies of the Gambia, Sierra Leone, the Gold Coast, and Nigeria.

5. *The Continent of America.*—The two American continents are similar in general structure, which is different from that of the other continents. North and South America each consists of a great mountain belt to the west, of a series of ancient highlands to the east, and of a vast plain between the two mountainous bands. The story of the formation of each continent is that of how two originally independent lands have been united into a single continent by the gradual filling up of the sea which divided them. The sea was reduced to two gulfs, which were in time converted into land by the deposition of the sedimentary rocks that now form the great plains.

(a) *North America.*—In North America the Western Mountain System extends from Alaska to the plateau of Mexico; its eastern front is known as the Rocky Mountains, while its western front consists in Canada of the Coast Ranges, and in the United States of the Sierra Nevada. Between the eastern and western marginal mountain chains are numerous mountain ranges, and also various basins; the most extensive is known as the Great Basin, and was once occupied by a great lake, of which the Salt Lake of Utah is now the remnant.

The highest peaks in the United States are in the Rocky Mountains (Gray's Peak, 14,341 feet); in Alaska are still higher mountains, including Mt. McKinley (20,300 feet), the highest in North America, Mt. Logan (19,540 feet), the highest in Canada, and the better-known peak Mt. St. Elias (17,879 feet).

From the eastern foot of the western mountains extend the Great Plains. They comprise in Northern Canada the barren Arctic tundras, farther south the wheat-fields of Central Canada, and in the United States vast areas of fertile prairies, corn-fields, and cotton-fields. The original northern extension of the plains has been dismembered into the islands of the Arctic Archipelago. On the mainland of Northern Canada the plains include the valley of the Mackenzie River, which discharges the overflow

from depressions occupied by the Great Bear Lake, the Great Slave Lake, and Lake Athabasca; these northern plains disappear eastward beneath the still greater basin of Hudson Bay. The plains in Canada rise southward to the 'height of land', the broad divide near the Canadian-United States frontier, south of which they continue as the basin of the Mississippi, and through it descend to the Gulf of Mexico. The drainage of parts of South-Eastern Canada, and the adjacent areas in the North-Eastern United States, is through the greatest lake-group in the world, including Lakes Superior, Michigan, and Erie, of which the waters are discharged over the Niagara Falls to Lake Ontario, and thence through the St. Lawrence to the Atlantic.

The eastern highlands of North America begin to the north with the ice-covered plateau of Greenland; they include the rocky peninsula of Labrador, the Island of Newfoundland, and the coastal provinces of Canada; they are continued in the United States by the Appalachian mountain belt, which separates the Great Plains from the Coastal Plain along the Atlantic.

The three separate divisions of North America yield such varied products as to render the continent self-supporting: the Great Plains raise cotton, corn, and cattle; the Eastern Highlands yield coal, oil, timber, and iron ore; the Western Mountains are rich in copper, gold, lead, and silver; while the Pacific coastlands yield gold, timber, coal, oil, and the abundant fruits of California.

The political division of North America is simple, and has been determined by its physical structure and conditions. The climate of the continent is controlled mainly by the variations in temperature, which are dependent primarily on distance from the tropics. Central America and the low-lying coastal districts of Mexico have a tropical climate with a mean annual temperature of not less than 80° F. Southern Florida and Southern California have mean temperatures of 75° F. The climate of most of the United States is temperate, in spite of the severity of the winter, during which the isotherm of 40° F. crosses the Canadian frontier near Vancouver, traverses the central states, where it passes close to Saint Louis, and reaches the Atlantic coast near Philadelphia. Southern Canada is mostly in the colder Temperate Zone, with the mean annual temperature of only 45° at Ottawa in Eastern Canada, and also in British Columbia in the west. Northern Canada has an Arctic climate, the mean annual temperature falling on Boothia Peninsula to 5° F., or 27° below freezing-point.

The lines marking the distribution of temperature do not follow the parallels of latitude,

but trend northward, as they cross the continent to the west, owing to the effect of winds and ocean currents. On the Pacific coast the mean annual temperature is higher than that of places at the same latitude on the Atlantic coast, hence the forests extend much farther north in Western than in Eastern Canada.

The European colonization of North America was begun in 1620 by British emigrants along the Atlantic coast, who were preceded by a French fur-trading station in Quebec established in 1608. The Dutch founded New York in 1623. After the War of Independence the British colonies became an independent republic as the United States. It was then a federation of thirteen states, with, in addition, the district of Columbia, the seat of the Federal Government. The number of states has since grown to forty-eight. The area of the republic has been extended by the purchase of Florida from Spain, of the lower Mississippi Valley from France, and of Alaska from Russia. Texas was added by mutual agreement. New Mexico and California were acquired by conquest from Mexico. The development of the country was first restricted to the Atlantic coast, except for the isolated Spanish settlements in California. The discovery of the Californian gold-fields in 1849 led to the development of the overland routes, and subsequently to the series of trans-continental railways, which have welded the country politically, and led to the settlement of the intervening country.

The development of the United States has been greatly aided by its rich mineral resources. Its output is greater than that of any other country in coal, iron, copper, and oil.

Canada was first settled by French colonists. It was conquered by the British in 1759. Its development was comparatively slow, being retarded by the cold climate. The large areas of wheat-growing country are separated from the coast by the rough forest-clad Eastern Highlands, and their utilization only became possible after the construction of railways to the eastern ports. West of the great wheat-fields of Manitoba and the surrounding provinces occur vast coal-fields, and still farther west, in the Coast Ranges beside the Pacific, important mining-fields yield gold, copper, silver, and lead. Fields of oil and natural gas occur under the western part of the Great Plains.

(b) *Central America and the West Indies.*—North and South America are joined by Central America; to the east of this great isthmus the Caribbean Sea and Gulf of Mexico occupy the site of a sunken land, of which the West Indian Islands are remnants. The structure of this land (Antillia) is very different from that of both North and South America, as its mountain ranges trend east and west, and in consequence

the chief islands Cuba, Jamaica, and San Domingo, are aligned in that direction. The still-continued subsidence of the floor of the Caribbean Sea is indicated by the violent earthquakes and volcanic eruptions by which Central America and the West Indies have been so often devastated.

Central America consists politically of a series of independent republics. The country was originally all Spanish, but it has gained its independence with the exception of the colony of British Honduras (capital, Belize). Mexico is the largest and most powerful of the Central American states. It consists in the main of a high central plateau which has steep slopes down to each coast, and includes the long peninsula of Lower California. Mexico is very rich in minerals, especially oil in the coastlands of the Gulf of Mexico, and silver and lead in the plateau. The other Central American states are: Guatemala, of which the commercial capital is Quetzaltenango; Honduras (capital, Tegucigalpa); Salvador (capital, San Salvador); Nicaragua (capital, Managua); and Costa Rica (capital, San José). In 1921 Guatemala, Honduras, and Salvador united as The Federal Republic of Central America. Panama was separated from Colombia by a revolt in Nov. 1903. The establishment of that state enabled the United States to secure control over the zone containing the Panama Canal. This ship canal, between Colon on the Atlantic side and the Gulf of Panama on the Pacific, enables ships to pass from the eastern to the western parts of the United States without the long voyage around Cape Horn.

The West Indies include two main series of islands, the Greater Antilles, including the four large islands Cuba, Jamaica, Haiti, and Porto Rico. They are arranged upon two convergent lines, and are fragments of the old mountain lines of the former land of Antillia. The second group, the Lesser Antilles, include the Bahamas, an archipelago of low islands north of Cuba and west of Florida, famous for their sponge fisheries; the Caribbean Chain between the Caribbean Sea and the Atlantic; the large island of Trinidad close to the coast of South America; and some islands in the Spanish Main off the coast of Venezuela. The political allegiance of the West Indian Islands is very diverse. Haiti consists of two independent negro republics; Cuba and Porto Rico are under the protection of the United States; Jamaica and Trinidad, the Bahamas, and most of the Caribbean Chain are British; the Virgin Islands, including St. Thomas, formerly Danish, were sold to the United States in 1916; Curaçao, Aruba, and half of St. Martin are Dutch; the other half of that island, with Guadeloupe and Martinique, is French. The islands are therefore under very varied political

influences; the cost of administration is high, and no general policy is practicable. Their chief industries are agriculture, the most important crops being tobacco (especially in Cuba), coffee, bananas, sugar, lime-juice, and other tropical products. Oil is found in Trinidad, and is known to occur in small quantities in some other islands. The inhabitants are mostly negroes, whose ancestors were introduced as slaves from Africa. The aboriginal people, the Caribs, are nearly extinct.

(c) *South America*.—The Western Mountain System begins to the north in chains which trend approximately east and west across Northern Venezuela; in the north-western corner of South America the mountain lines bend round to a meridional direction, and continue as the Andes throughout the length of the continent; at its southern end the main mountain line bends again eastward through the Southern Argentine and Tierra del Fuego, and was probably continuous across Drake's Strait with the mountain chain of Graham Land.

At the eastern foot of the Andean Mountains lie the Great Plains, which extend from the valley of the Orinoco southward through the forests of the Amazon to the Parana and the grassy plains of the pastoral lands of Argentina. The Eastern Highlands in South America are much wider than the corresponding element in North America. They include the highlands of Guiana, north of the Amazon, and the wide plateau, known as the Brazilian Highlands, which extends from the Amazon to the La Plata. This plateau reaches the coast, and must formerly have been continuous across the Atlantic with the similar plateau of Equatorial Africa.

Most of the western coast is occupied by a narrow coastal belt with low ancient hills; but in Southern Chile and Patagonia this strip has been fractured and submerged to form the archipelago and fiords of Patagonia.

South America consists politically of ten independent republics and of three European colonies, British, French, and Dutch Guiana. The country was originally mainly occupied by Spain, attracted primarily by the mineral wealth along the Andes. The Portuguese settled on the coast of Brazil. A Bull of Pope Alexander VI separated the spheres of Spain and Portugal by the line of no magnetic variation, that is, the line on which the magnetic compass points due north. This line then crossed Brazil; but it is not fixed in position, and as it moved eastward into the Atlantic the frontier was resettled by the Treaty of Tordesillas (1494), which left Eastern Brazil to Portugal, and its colonization and language are Portuguese. The rest of the continent was developed under Spanish influence, and its language is Spanish.

The South American states include Venezuela (capital, Carácas), which lies along the southern coast of the Caribbean Sea, and includes most of the basin of the Orinoco. The Republic of Colombia (capital, Bogotá) extends along the north-western chains of the Andes and the valley of the Magdalena; it also includes the upper basin of the Orinoco and the north-western tributaries of the Amazon. Ecuador, established 1830 (capital, Quito), is the smallest of the western states. It lies along an important trade route over the Andes, from the Gulf of Guayaquil to the Upper Amazon. Peru (capital, Lima) gained its complete independence in 1824; it lies along the parallel chains of the Andes, and includes a series of wide valleys and basins, of which the most important is that of Lake Titicaca (altitude, 12,500 feet). Chile (capital, Valparaíso) won its freedom in 1818; it is a long, narrow state ranging for about 2700 miles along the Pacific Coast, from Arica in the tropics to Cape Horn. It extends along the Andes, between the chief chains of which lies the Great Valley of Chile; this valley continues southward as a series of straits and channels, owing to the western chain of the Andes having been broken up into the fiord coast of Patagonia. The Argentine, founded in 1810, the second largest of the South American states, extends from the Andes to the Atlantic; it includes vast grass-covered plains, now occupied as great sheep- and cattle-stations. Its capital, Buenos Ayres, is one of the chief ports of South America.

Brazil, founded in 1822 (capital, Rio de Janeiro), is the largest of the South American states. It includes most of the valley of the Amazon, as well as the upper basin of the Rio de la Plata. Its eastern division consists of a high irregular plateau containing important gold-fields. The lowlands of the Amazon and along the coast have large rubber plantations. Uruguay (capital, Montevideo) first obtained its independence in 1817, and had it guaranteed in 1828; the state lies along the Atlantic coast, north of the estuary of the La Plata. Bolivia and Paraguay are the two inland states. Bolivia (capital, La Paz) is on the highlands of the water-shed between the Amazon and the western tributaries of the La Plata. Paraguay (capital, Asunción) lies between various tributaries of the Parana, by which it has water communication with Buenos Ayres and the sea.

The first attraction of South America to European settlers was the wealth of its western mines. Their richness in gold and silver led to the conquest and development of the countries along the Andes; the mines of Chile at one time produced a larger output of copper than those of any other state in the world. The tropical states are rich agriculturally, producing especially

rubber, tobacco, and quinine. The southern plains are one of the great pastoral areas of the world. The development of the eastern and central areas is facilitated by the easy navigability of the great rivers. Ocean-going steamers, for example, ascend the Amazon to Iquitos, 2000 miles from its mouth.

The three colonies of British Guiana (capital, Georgetown), Dutch Guiana (capital, Paramaribo), and French Guiana (capital, Cayenne) extend from the Atlantic coast east of the Orinoco southward to the water-shed of the Amazon, which forms their boundary from Northern Brazil.

The aboriginal inhabitants of South America were tribes of American Indians; their descendants are the basis of the native population, and their physiognomy shows marked Mongolian characteristics. For the cultivation of the plantations of Brazil and Guiana slaves were imported from Africa, and thus the negro is an important element in the existing population of the eastern parts of the continent.

6. *The Continent of Australia*.—Australia is a southern extension of Asia through the Eastern Archipelago. It includes nearly 3,000,000 sq. miles, and extends for 2400 miles from east to west, and for 1970 miles from north to south. Its western part consists of the ancient plateau of Western Australia, which has an arid climate, and is bounded to the west by the mountain front known as the Darling Range, and descends slowly eastward to the Great Plains. They extend from the Gulf of Carpentaria across Western Queensland and New South Wales to South Australia, where, in Lake Eyre, their basin lies 39 feet below sea-level. These plains include large areas of valuable pastoral country and the basin of the greatest Australian rivers, the Murray and its long tributary the Darling. The Great Plains are bounded to the east by the East Australian Highlands, which extend from the Cape York Peninsula in the north, throughout the length of Australia, to Bass Strait, to the south of which the mountainous island of Tasmania consists of a detached fragment of this highland belt. The East Australian Highlands include Mt. Kosciusko (7308 feet), the highest summit on the continent.

The plateau structure of Australia has greatly hampered its development. The coastal plains are narrow, and the ascent from them, especially along the eastern side of the continent, is so abrupt that it was long before explorers could find a way from the coast into the interior. The steepness of the ascent inland from all the capital cities has been a constant hindrance both in the construction and working of the Australian railways. The abrupt rise of the highlands near the coast has another and still more pre-

judicial influence on the development of Australia by causing the unequal distribution of the rainfall, which is concentrated on a narrow marginal belt owing to the sudden uplift and chilling of the air. The rainfall is therefore often excessive on the highland edge, and inadequate in the interior. These conditions have led to the popular misconception of Australia as a narrow ring of fertile country around a vast internal desert. The minimum rainfall, less than 5 inches per annum, occurs around Lake Eyre in South Australia; thence westward is a wide tract with an arid climate and a rainfall of between 5 and 10 inches. Thanks, however, to the effect of the monsoons, large parts of North-Western Australia have a rainfall of from 10 to 20 inches, and cattle-stations now occupy areas formerly represented as impassable and useless desert. The areas with a rainfall of over 40 inches are all coastal; they include the south-western corner of the continent around Cape Leeuwin, the Northern Territory, the Highlands of Victoria, Tasmania, and a belt behind the eastern coast, wherein the rainfall is especially heavy in the north at Innisfail in Queensland, amounting to 149½ inches as an average for twenty-five years.

The East Australian Highlands and the plains to the west of them, owing to the warm climate and rainfall from 15 to 30 inches, are covered with rich turf, and are well adapted to sheep-farming. Australia, therefore, made its first important progress by the pastoral settlement of these plains. Melbourne, founded in 1835, was the first important centre of extensive pastoral development, owing to its easy access to the lava plains of Victoria. As the sheep-stations required but little labour, the population remained small, and in 1840 was only 190,000 in the whole continent, exclusive of aborigines. In 1851 the first important discoveries of gold led to an inrush of population and the rapid development of the continent. The population multiplied seven-fold in the next sixty years. The most important of Australian minerals has been gold, especially from the mines in Victoria, Queensland, New South Wales, and Westralia; copper is mined in South Australia, Tasmania, and Queensland; lead, silver, and zinc at Broken Hill in New South Wales; and tin and copper in Tasmania. One of the world's great coal-fields underlies the coastal regions of New South Wales between Sydney and Newcastle; coal-fields also occur in South-Eastern Queensland. Large deposits of iron ore are known in Tasmania, South Australia, Queensland, and Westralia.

The rapid development of the continent after the mineral discoveries led to its existing political subdivision. The whole continent was originally

all included in the colony of New South Wales. Tasmania was separated in 1825. Western Australia, conveniently known as Westralia, was separated in 1829 after the establishment of the Swan River settlement around the present capital of Perth, owing to its remoteness from Sydney. South Australia was founded in 1836 as a political experiment, with its capital at Adelaide. The discovery of the Victorian gold-fields led to the conversion of the Port Phillip district into the colony of Victoria, with Melbourne as its capital, in 1851. Queensland was separated in 1859, with its capital at Brisbane. The Northern Territory remained at first part of New South Wales, from which it was completely isolated; so in 1863 it was placed under the administration of South Australia.

The Federal Government for Australia, established in 1901, has taken over some of the duties of government in all the states, and is solely responsible for the administration of the Northern Territory, of the Federal District, which includes the site of Canberra, the future Federal capital; also of Papua, the British part of New Guinea, and some Pacific islands that formerly belonged to Germany.

With the decline of the predominance of metal-mining in Australia, the pastoral, agricultural, and dairy industries have become by far the most important source of Australian wealth. The value of the total production of Australia in 1918 was £300,000,000, of which various kinds of farming together yielded nearly two-thirds (or £190,000,000). Manufacturing yielded a quarter (£75,000,000), and mining under one-tenth (£26,000,000).

7. *The Pacific Islands*.—When the Pacific was seen by the Spanish explorers from above Panama, as it lay to the south of that isthmus, they called it the 'South Sea', a name now retained only in that of the South Sea Islands. The distribution of these islands appears at first irregular; but, according to their geographical arrangement and geological structure, they may be divided into five well-defined groups. East of Australia lies a series of islands known as the Australian Festoon, of which the structure is continental; they range from New Guinea through Melanesia, Solomon Islands, and New Caledonia to their most important member, New Zealand. Farther east lies the Micronesian Festoon; it is composed of volcanic and coral islands, and rises from a platform separated from the rest of the Pacific floor by a series of deep trenches, of which that south-east of the Tonga Islands is the most remarkable of known sub-oceanic valleys. Beyond the trench, bounding Micronesia, occurs the South Pacific Chain; it extends from the Phoenix Island east-south-eastward through the Society Island (Tahiti)

and the Paumotu or Low Archipelago to Easter Island, which is shown by its gigantic stone statues to have been occupied by a Polynesian race that came from the west. The North Pacific Chain includes the Hawaiian Archipelago. In the far northern Pacific the Aleutian Festoon tends to connect Kamchatka and Alaska. In the west Pacific the chain of the Pelew and Ladrone Islands, to the north of New Guinea, lie along a ridge between the Challenger Trench to the east and a broad deep basin south of Japan.

8. *Antarctica*.—Antarctica is the least known of the continents. Its existence was accepted by mediæval geographers from theoretical considerations. It was first circumnavigated by Captain Cook. Modern explorations have proved that it is a continent formed of a high ice-clad plateau. South Victoria Land and Wilkes Land continue southward the structure of Australia, while Graham Land, opposite South America, is traversed by a lofty mountain chain which appears to represent a structural continuation of the Andes.

B. The Oceans

The sea occupies five-sevenths of the earth's surface, and its chief divisions are the five oceans. The Atlantic forms the long sinuous trough between the Americas and the Old World. The Pacific, the largest geographical unit on earth, separates America from Asia and Australia, and ends southward against Antarctica. The Arctic Ocean around the North Pole occupies a deep basin connected by shallow broad outlets to the Atlantic, and by the narrow Behring Strait to the Pacific.

The Indian Ocean is comparatively small, and forms the basin between Southern Asia, Africa, and Australia, and ends to the south along about 35° s. lat. The Southern Ocean extends from South America and Graham Land eastward to New Zealand, and includes the long belt of sea to the south of the Atlantic and Indian Oceans and of Australia. The Southern Ocean and Southern Pacific together form a continuous ocean belt around the southern hemisphere.

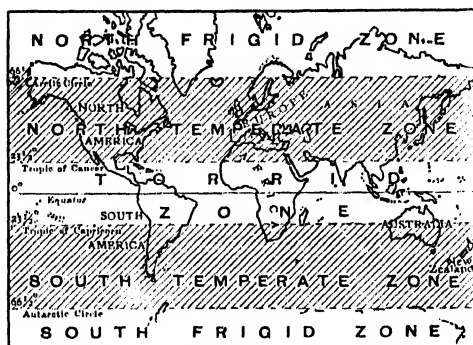
III. WEATHER AND CLIMATE

The economic value of a land depends, as a rule, mainly upon its climate, which is the average of its weather. Climate depends mainly on the distribution of heat and moisture. The heat is received from the sun, and the moisture from the sea. The heat from the sun is very unevenly distributed upon the earth, as areas which are almost at right angles to the sun's rays receive more heat than those where the rays fall very

obliquely upon the surface, so that the heat is more widespread, and more is absorbed by the atmosphere owing to the longer passage through it.

The irregularity in the distribution of heat is reduced by the earth's axis of rotation being inclined to the plane of its orbit. The sun accordingly passes sometimes north and sometimes south of the equator; the polar regions receive more heat than would reach them if the equator and ecliptic were coincident. If the amount of heat received by a place on the equator be taken as 100, a place at the latitude of 30° would receive 88 per cent; at lat. 45° , 74 per cent; at lat. 60° , 57 per cent; and at lat. 75° , 45 per cent; and 41 per cent at the poles.

The earth is divided into five zones, distin-



Map of the World showing the Zones

guished by their position in respect to the sun. The Torrid Zone lies between the two tropics, and includes the belt over which the sun is sometimes directly overhead. The two Temperate Zones, between the parallels of about $23\frac{1}{2}^\circ$ and $66\frac{1}{2}^\circ$, are those in which the sun is never directly overhead, but rises above the horizon every day in the year. In the two Frigid Zones, which include the areas north of $66\frac{1}{2}^\circ$ N. and south of $66\frac{1}{2}^\circ$ S., the sun during some days of the year does not appear above the horizon; the long winter night thus caused reaches its maximum of six months at the poles. The Polar Regions are the coldest, owing to the obliquity of the sun's rays there, and the darkness and severity of the winter is fatal to many forms both of animal and plant life.

The moisture that falls as rain and supplies the lands with fresh water is raised from the sea by evaporation, which is greatest within the tropics. The moisture is driven along by the winds until it is precipitated by an adequate fall in temperature. When the air is cooled to a degree at which it is 'super-saturated' with

moisture, the excess is precipitated as dew, rain, snow, or hail. The two main causes of precipitation are the uplift of air into a higher, colder level of the atmosphere, and the fall of temperature at night, which causes the deposit of dew. As the air is blown against rising land, it is forced upward and thus chilled, and part of its moisture is precipitated. Hence rainfall is, as a rule, greatest where air that has been carried inland from the oceans is uplifted against the mountains. Thus the rainfall at Cherrapunji, the highest in the world, with an average of over 500 inches a year, is due to the moist air from the Bay of Bengal being uplifted over the mountains of Assam. Similarly, the highest rainfall in the British Isles occurs along the western mountains, where the air from the Atlantic is uplifted and cooled.

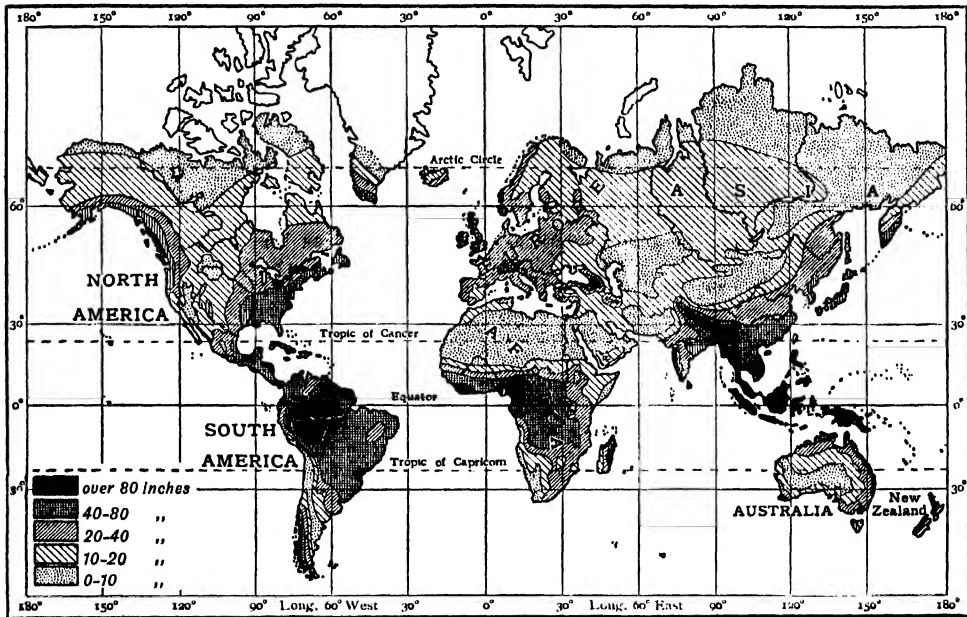
The circulation of air by the wind is the chief factor in the distribution of moisture and of rain. The main movements of the air are: (1) a general drift eastward, owing to its lagging behind the ground beneath it during the rotation of the earth. (2) The Trade Winds (so-called from the former use of the word 'trade' for a path or passage) are due to the air being drawn northward and southward in order to replace that which rises above heated tropical areas. These winds are deflected from their course due northward or southward owing to the rotation of the earth. In the northern hemisphere they blow from north-east to south-west, and in the southern hemisphere from south-east to north-west. (3) The Anti-Trades. The air carried towards the equator by the Trade Winds is returned by a high-level current in the opposite direction. This air, becoming chilled, falls to the surface of the earth outside the Trade Wind belt, and there gives rise to strong, steady winds that blow in the opposite direction to the Trade Winds. They are known as the Anti-Trades or Counter-Trades. In the northern hemisphere they blow from the south-west; in the southern hemisphere they blow from the north-west, and as the sea extends uninterruptedly around the world in the zone of the southern Anti-Trades, the winds are of special power in the belt south of 40° , which is known as the 'Roaring Forties'. (4) The Monsoons are a series of regular winds around the Indian Ocean which change their direction twice a year. The name is derived from the Arabic word for the seasons. They are due to the main ascending air-current shifting its position with the sun; it does not always rise above the equator, but above the 'thermal equator', the line over which the sun passes in the daily rotation of the earth. This line moves northward and southward. During the northern summer it lies across Southern Asia, and causes a great ascending air-current over

South-Central Asia. This air is replaced by a current from the Indian Ocean; so from April to October the monsoon blows from south-west to north-east. During the northern winter the sun travels across the earth south of the equator; the highlands of Central Asia are then cold, and a descending air-current upon them produces winds which blow outward to the Indian Ocean. Hence from October to April the monsoon blows from north-east to south-west.

In the Temperate Zones the air movements

drop its moisture as rain until it has been sufficiently uplifted to be cooled below its temperature on the sea. Parts of the coast of Chile and Peru, of South-Western Africa, and Somaliland, owing to these conditions, have arid climates.

The agricultural value of rain depends upon its distribution through the year and the period of its fall. In the monsoons, as the ascending air-currents over the land occur during the summer-time, the monsoonal regions have summer rains and dry winters. In the Trade Wind



The World: Mean Annual Rainfall

are irregular. They are due to circular wind systems around areas of low pressure known as cyclones, and around areas of high pressure known as anti-cyclones. As in cyclones the air is ascending, they are accompanied by rain. As the air in anti-cyclones is falling, the conditions under them are dry. The cyclones and anti-cyclones travel from west to east; but as the winds around them are circular, the regions crossed by them are subject to winds which are inconstant alike in strength and direction.

The air circulation, therefore, controls the rainfall, and mere proximity to the sea does not ensure a good supply of rain. Where the sea-water along a coast is cold, the air that blows ashore has its temperature raised and its capacity for carrying moisture increased by the greater heat of the land; hence this air does not

belt, as the western coastlands have off-shore winds, they are usually dry; and as on the eastern side of the continents the Trade Winds blow in from the sea, the rainfall on them is heavy and mostly falls in the winter months. The Mediterranean type of climate is that in which the rainfall is mainly in the winter and the summers are dry; it occurs on the outer side of the Trade Wind belts, especially along the Mediterranean, along some of the western coasts of America, South-Western Africa, and Southern Australia.

The winds have a powerful effect upon climate by controlling the distribution of sea-water, and by drawing up to the surface some of the almost ice-cold deep-sea water, which has a chilling effect on the weather.

The ocean controls the environment of man

on earth. From its surface is raised the water which maintains the rainfall and renews the rivers. It modifies the temperature of the winds which blow across them; it prevents injurious variations in the composition of the atmosphere by absorbing any excess of carbonic dioxide after volcanic eruptions, and by giving forth fresh supplies to replace the amount removed by absorption during the growth of vegetation or by the weathering of rocks. The deeper water of the oceans is almost ice-cold, having a temperature of about 39° F. Its coldness is due mainly to the melting of the Antarctic ice, for the cold, heavy water thus produced sinks to a great depth and then drifts northward; this explanation is based on the fact that the deeper waters of the North Atlantic and North Pacific are slightly less cold than those of corresponding positions in the southern parts of the same oceans. The temperature of the surface-waters of the ocean varies in accordance with the amount of heat received from the sun; it is warmest in the tropics, and the greater evaporation in that zone renders the surface-waters there saltier than those in the Polar Regions, where the upper layers are diluted with fresh water from the melting ice. The salinity is also low off the mouths of large rivers, where the fresh water spreads out as a wide, shallow layer floating on the heavier sea-water. The amount of salt in the sea-water is on an average about 35 parts in 1000, but it rises to more than 42 parts in some tropical enclosed seas, as at the northern end of the Red Sea, and falls below 30 parts in the Baltic, where the long-continued inflow of fresh water from the rivers has rendered the water in the northern part little more than brackish.

The surface-waters of the ocean are pushed forward by the winds, thus giving rise to broad, slow movements known as drifts, and to narrow, swifter, and more constant streams known as ocean-currents. The equatorial parts of the oceans are mostly subject to a westward drift under the influence of the Trade Winds. In the mid-temperate zones the drift is mainly eastward under the pressure of the prevalent westerly winds. When the drift is obstructed by coming against a continent, the water is piled up, and the excess overflows as an ocean-current. In the Atlantic the equatorial drift from east to west drives water into the Gulf of Mexico; thence it escapes as the Gulf Stream, which can be traced by the warmth and saltiness of its water to Newfoundland. It is there dissipated, and the surface temperatures are lowered by the Labrador current, which flows southward from the Greenland seas. In most of the North Atlantic there is a widespread drift, proved, for example, by parts of ships which have been

wrecked in America being washed ashore on the coast of Europe. The water carried eastward by this drift is forced against the coast of Southern Europe, and is piled up there in a raised area, whence a regular outflow, the European Current, discharges northward past the British Isles and helps to warm the seas of North-Western Europe. The Canaries Current from the same area discharges southward along the West African coast. In the South Atlantic some of the water that has drifted eastward across the Southern Ocean is driven against the western coast of South Africa, and thence flows north as the Benguela Current. The water of the western equatorial drift across the Atlantic impinges against the coast of Brazil, and then flows southward along the American coast as the Brazil Current.

The circulation in the Pacific is essentially similar to that in the Atlantic. A broad westward drift across the equatorial zone piles up water against the coast of China, whence a current known as the Kuro Sivo flows northward past Japan; it corresponds to the Gulf Stream. A current from Kamchatka flows southward to Japan, and corresponds to the Labrador Current that discharges into the North Atlantic from Greenland. An eastward drift across the North Pacific banks water against the western coast of the United States; the overflow southward is the Californian Current, which corresponds to the Canaries Current in the Atlantic. In the South Pacific the eastward drift of the cold sub-Antarctic water is deflected northward by the obstruction of South America, and flows along the coasts of Chile as the Peruvian Current; this stream is dissipated near the equator, and its waters are returned westward across the tropical Pacific in the southern equatorial drift.

In the Southern Ocean a predominant easterly drift is maintained by the west winds, which give the belt east of Cape Colony its name of the 'Roaring Forties'. This drift feeds the Benguela and West Australian Currents.

The climatic effects of ocean-currents have been often over-estimated; to them have been attributed the greater warmth of the eastern as compared with the western coasts of the North Atlantic. The warm temperature of the British Isles is, however, due more to the warmth of the prevailing south-west wind and to the latent heat set free by the precipitation of its moisture than to ocean-currents.

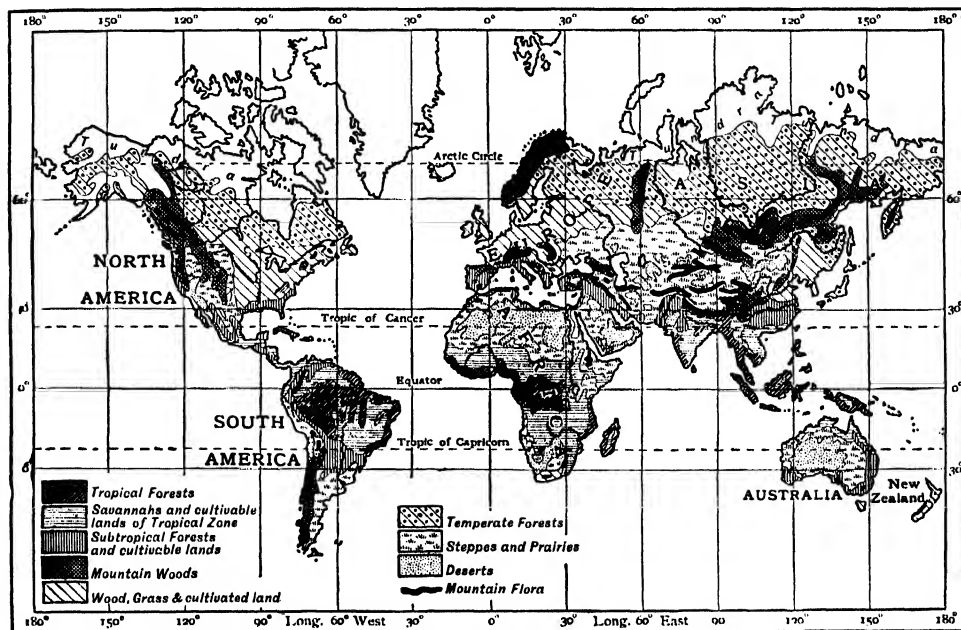
IV. THE DISTRIBUTION OF PLANTS

The distribution of plants is controlled by two series of factors—climatic and edaphic. The edaphic are those dependent on the soil, its textures, its properties as regards water, its

supply of plant foods, and the presence or absence of poisonous constituents, some of which are fatal to special plants, and others to all plants. The climatic effects are due mainly to variations in heat, moisture, and light. Heat has the broadest general effect on the distribution of plants, so that the character of the vegetation varies primarily with distance from the tropics. The secondary variations depend on distance from the coast, which affects the supply of moisture, and on height above sea-

flowering plants live on the roof or attached to the tree trunks, up which they climb towards the light.

Muddy tropical coasts are often fringed with forests of mangroves, which are restricted to the tidal belt by their heavy dart-like seedling being fixed by falling from the parent tree into the mud. Sandy tropical shores and low islands, the soils of which are often saturated with salt water, support groves of coco-nut palms. The palms are characteristic of the tropics, and they



The World: Vegetation

level, which largely controls the local temperature. For areas with similar positions and soils, distance from the equator is the dominant factor. The primary botanical divisions are therefore into seven parallel zones, the Tropical, North and South Subtropical, North and South Temperate, and the Frigid Zones, Arctic and Antarctic.

In the tropics, lowlands and mountain slopes which receive heavy rain are usually covered by dense forests with luxuriant foliage. These forests may have a jungly undergrowth through which passage may be difficult; or the ground may be open and the foliage form a high canopy, supported by a web of lianas or other twining plants which connect the crowns of the trees. Under such a roof dense undergrowth is impossible, owing to the lack of light; and most of the

grow isolated or in clusters, or as open forests, on the plains. At some distance from the sea and in the drier areas forests give place to park-like grassy plains with scattered trees. In areas with a still more arid climate the conditions become those of the desert. The continuous turf breaks up into scattered tufts of dry grass; the herbs grow in cushion-like masses; shrubs have thick and fleshy leaves and stems like the aloe and cactus; the trees have needle-shaped instead of broad flat leaves, and their trunks may be succulent like the giant euphorbias, or may be huge masses of soft wood like the baobab. These modifications are adapted to reduce loss of water by evaporation. The trees, moreover, in arid regions often have a growth of thorns to protect them from animals ravenous during drought; and they are often

umbrella-shaped in order to lessen their resistance to the wind.

The Subtropical Zones have forests of hard-leaved evergreen trees, such as the cork-oak; they grow in areas with a Mediterranean rainfall, as along the Mediterranean, in California, South-Western Africa, and South-Western Australia. The structure of their leaves reduces loss of moisture during the long dry summer. In other parts of the Subtropical Zone are forests of conifers, such as the Italian and the Aleppo pines.

In the colder parts of the North Temperate Zone the characteristic trees, e.g. the oak, beech, elm, ash, and birch, are deciduous; they shed their leaves in the autumn, whereby their foliage is not subject to frost, and the trees offer less resistance to winter gales. The hills are often covered by vast forests of spine-leaved trees, e.g. pines and firs. The plains and downs are clad in turf, and form the world's most extensive grazing-lands. The arable ground, owing to the moderate cold in winter and heat in summer, is especially favourable for cereals, although, unlike the tropics, as a rule only one crop can be reaped in the year.

In the Frigid Zones the growth of trees is prevented by the darkness and intense cold of winter. The vegetation consists of turf and low herbs, which are protected during the winter by a mantle of snow. The frigid plains are usually occupied by vast swamps, which are kept saturated by the melting of snow and ice in the spring, while the summer is too short to drain the soil. The Arctic plains are usually covered by a growth of moss and lichens and of swamp-dwelling plants (hydrophytes), such as rushes and sedges, which can withstand both cold air and a water-logged soil.

V. THE DISTRIBUTION OF ANIMALS

The Darwinian theory of evolution was based on the struggle for existence due to animals and plants increasing much faster than the food-supply. The descendants of a single pair of rabbits, which breed six times a year and produce in each litter from three to eight young, who begin to breed when six months old, or of a single breed of rats, which breed as often and as early and produce from four to ten young in each litter, would, if they all reached maturity, overrun the earth in a few centuries. A single pair of rats would increase to over 11,000 in two years. Comparatively few of the young of fast-breeding animals can reach maturity. One of the most immediate methods by which any animal or plant can relieve the fierce competition among its species caused by the rapid increase in its numbers is by spreading outward

from its centre of origin and occupying every accessible region which is suitable to it or to which it can adapt itself. Animals, in the struggle to extend their geographical range, adapt themselves to different climates and perhaps to other media. Land animals have given rise to aquatic types such as the seal; the descendants of fish have become amphibious; and the Amphibians have given rise to terrestrial quadrupeds.

The distribution of animals is restricted by various factors, climatic and geographical. Some animals are so sensitive to cold that they are restricted to the tropics; and to some salt water is so fatal that they have no power of passage over sea. Examples of restricted ranges are supplied by the anthropoid apes, which are confined to Western and Central Africa and South-Eastern Asia; the musk ox, limited to Arctic America; the elephants, now restricted to Africa and Southern Asia; and the monotremes (e.g. the duck-billed platypus), found only in Australia and New Guinea. In contrast to these restricted groups others are world-wide. Some animals have such powers of accommodation to changes of temperature that they range across all the climatic zones. Thus the tern (*Sterna arctica*) extends from high Arctic to high Antarctic latitudes; the tiger lives in the tropical jungles of Southern India and in the frigid steppes of Siberia. The wide distribution of some birds is due to their powers of flight. For example, a swallow hatched in England has been caught in Natal. The dog has been artificially distributed as the companion of early man, who doubtless introduced the dingo into Australia. Mice and rats have been unintentionally carried in boats and spread on floating trees, which supplied both food and transport. There are, however, many cases of wide distribution that do not admit of such simple explanation. Normal distribution is 'continuous'. Thus the bird known as the dipper ranges from Ireland, Spain, and Morocco, across Europe and Central Asia, to the coasts of China and Japan. Its distribution across that area is continuous. It also occurs in Western America, but that its range to that area was continuous is shown by its occurrence in Southern Kamchatka and the Aleutian Islands, which served as stepping-stones between Asia and America. The diprotodon Marsupials (e.g. kangaroos and wallabies) are now confined to Australia with the exception of one animal, the opossum rat (*Cenolestes*), which lives in the north-western corner of South America. The distribution of the Diprotodons is, therefore, discontinuous, and there are no intermediate colonies connecting *Cenolestes* and its Australian relatives. The alligator is characteristic of tropical and sub-tropical America, but an isolated colony of it lives in the Yangtze-kiang in China.

The chief home of the lizards, the Iguanas, is southern North America and South America; but isolated representatives live in Madagascar, and in the Fiji and Tonga Islands in the South-Western Pacific. Such cases of 'discontinuous distribution' indicate either survival from a time when the arrangement of land and water on the globe was very different from the present plan, or the dispersal of eggs or larvæ by some agent that can cross wide tracts of sea. The dispersal of plants is helped by the seeds being carried by wind and animals; larvæ or eggs may be carried across sea in mud on the legs of birds. Ocean-currents may carry small animals or larvæ on floating timber or in pumice. The occupants of islands lying near a continent are introduced by such agencies, for they are allied to those of the adjacent land, and are usually only such as may be thus carried. Remote small oceanic islands are inhabited by the few animals and plants that have been carried by wind or sea-drift, or been introduced by man. The study of such islands shows that birds are of little importance in the distribution of other animals, and that though winds and currents may introduce insects and small animals, such cases are exceptional. These adventitious methods of distribution are inadequate to explain the range of some animals, such as the occurrence of the same mammals on both sides of the Atlantic, or the arrival in remote oceanic islands of mammals or animals dependent on a particular food to which salt water is as fatal as it is to slugs and worms. Discontinuous distribution generally indicates former connections which have now been broken by bridges of land having sunk beneath the sea. Animals which appeared on the earth in early times, therefore, had better chances of securing a wider distribution than those developed more recently, and would have spread along different routes. The distribution of plants and animals varies with the date of their appearance on the earth.

The chief facts of the distribution of animals are summarized in the classifications of the world into different zoological regions. The classifications proposed vary according to the group of animals selected as their foundation. The earliest standard classification (proposed by P. L. Scater in 1858) was based on the birds. He divided the world into six zoological regions: The Palearctic Region, including Europe, some of the Mediterranean provinces of Africa, and nearly all Asia; the Ethiopian Region, including Africa south of the Sahara, and Southern Arabia; the Oriental Region for South-Eastern Asia, including India, Indo-China, Siam, and the western part of the Eastern Archipelago; the Australian Region, including Australia, New Guinea, the adjacent part of the Eastern Archipelago,

and the islands of the South-Western Pacific; the Nearctic Region, North America as far south as the plateau of Mexico; the Neotropical Region, including Central America, the West Indies, and South America.

Lydekker (1896) pointed out that Scater's divisions were of unequal value, and advanced a classification based mainly on the mammals, and having due regard to their geological history. He subdivided the world into three realms; of these Arctogeia includes Scater's Palearctic and Nearctic, owing to the striking resemblance of the fauna of Canada to that of the Old World; Canada and the Lake Region of the United States are included in the same subdivision, the Holarctic Region, as Europe and Asia. The United States, having a fauna very different from that of Europe and Canada, belong to an independent region, the Sonoran. Africa south of the Sahara and Southern Arabia form the Ethiopian Region, from which Madagascar is separated as the Malagasy Region. South-Eastern Asia is the Oriental Region. Lydekker's second realm, Neogeia, includes South and Central America. His third realm, Notogeia, includes four regions—the Australian, Polynesian, Hawaiian, and Austro-Malayan (the eastern part of the Eastern Archipelago).

The inclusion of both the Nearctic and Palearctic in the Arctogeia Realm is based on the occurrence on both sides of the North Atlantic of many animals, including the moles and beavers, bears, reindeer and elk, the grouse, and the salamander, and amongst freshwater fish, perches, sticklebacks, pike, and sturgeon. The characteristic animals of the Palearctic Region include the wolf, the hedgehog, fallow deer, the two-humped camel, yak, and in the far north the lemming. Many of its mammals are the same as those of the Ethiopian and Oriental Regions; the porcupine, for example, ranges northward from Africa into Italy, the apes to Gibraltar, and the lion, which is characteristically Ethiopian, lived until recently in the Atlas Mountains of North Africa, during Old Testament times in Palestine, and still survives in Western India. The Ethiopian Region is characterized by the African elephant, the hippopotamus, the two-horned rhinoceros, the giraffe, many species of antelopes, the earth-pig or Aardvark, the guinea-fowl, and the primitive lemur known as the Aye-Aye. The ostrich is typically Ethiopian, but ranges through Arabia as far north as Palestine. The Oriental Region is characterized by the Indian elephant, the tapir, the orang-utan, the flying-lemurs, and many special species of antelope. Some antelopes occur in Northern Asia, and the tiger ranges from the jungles of India and Indo-China to Siberia. The Australian Region is specially characterized by including

the few living representatives of the monotremes, and all the Marsupials except the American opossums and the South American opossum-rat (*Cænolestes*); the Australian Region includes amongst birds the birds of Paradise, the bower birds, the lyre birds, the cassowaries, and emus. New Zealand, which has no indigenous mammals, includes the remarkable three-eyed lizard, the Tuatera or Hatteria, and the wingless birds, the kiwis; it is only in modern times that its great flightless birds, the moas, have become extinct. The Neotropical Region is the special home of the sloths and the ant-eaters, while it is occupied by special families of monkeys (the *Cebidæ*), the opossum-rat (*Cænolestes*), many special families of birds, including the great walking birds, the rheas; the llamas, vicunas, and jaguars are its best known larger animals.

Many animals, doubtless of South American origin, such as the armadillos, range northward into the Sonoran Region of North America, along with humming-birds, pumas, and alligators.

The faunas and floras of most of the continents and continental islands are composite, having been derived from various sources. This fact may be illustrated by reference to the British Isles. The oldest constituent in their fauna and flora is the Lusitanian element, which is found chiefly in the west of Ireland. It includes such plants as the strawberry tree, the *Arbutus unedo*, which is found elsewhere in Europe only in Spain, Portugal, and along the Mediterranean; similar in range is a 'spotted slug' (*Geomalacus*) which lives in the south-west of Ireland and the north-west of Spain, or the saxifrage, well known as a garden plant under the name of London Pride, which occurs in the west of Ireland, in Spain, and the Pyrenees. These organisms are all absent from England and France. The Irish members of the Lusitanian fauna and flora are, therefore, clearly survivals from a time when Ireland and Spain were directly connected by land. During the Great Ice Age most of the Lusitanian species were killed off; when the climate again became milder the severance of the former land connection prevented the entrance of new immigrants from Spain. The British Isles were therefore mainly peopled from Germany across the site of the North Sea. Hence the predominant British element is the Teutonic. An earlier immigration along the same line introduced the Alpine flora, of which many plants are still found on the higher British mountains. They have often been regarded as due to migration from the north, but they appear to have come from Asia in pre-glacial times across Central Europe. An American element in the British fauna and flora is represented in Ireland and Western Scotland by some American plants (e.g. the Pipe-wort

Eriocaulon), the introduction of which has been attributed to seeds drifted by ocean-currents; but this explanation cannot be applied to some American freshwater sponges which are found in lakes in Western Ireland. The presence of these American animals and plants in the British Isles is doubtless a result of the direct land communication across the Atlantic, which has caused the numerous affinities in their faunas and floras that has led to the inclusion of both Canada and Northern Europe in the same Holarctic Sub-region.

Oceanic Zoological Provinces.—The ocean is more favourable than the land to a wide range of inhabitants, owing to the continuity of the sea and the uniformity of temperature below the surface layer. The distribution of marine organisms is mainly determined by depth, for the deep sea is of almost icy coldness, and apart from the light given by phosphorescence it is dark; in the consequent absence of plant-life all the dwellers in the deep sea are carnivorous. The distribution of marine-life is into three divisions. The first is the Littoral Zone, which extends from high tide to the depth of about 40 fathoms; its water varies in temperature with the latitude and the seasons; and as it is illuminated from the surface, and constant movement keeps its waters well supplied with oxygen, it is usually rich in plant and animal life. The second division is the Pelagic Zone, comprising the surface-waters of the oceans far from land; the dwellers in it always float; they are the Plankton, which merely drift, and the Nekton, which swim. The third division, the Abyssal Zone, is the deep sea, and the conditions of its inhabitants are controlled by the enormous pressure, the stillness of the water, and the absence of sunlight and plant life.

Owing to the free communication between the different oceans, biological marine provinces are less marked than those of the land. The classification by Ortmann is based mainly on climate and depth. It adopts three Pelagic Regions—the Arctic Pelagic Region, which includes the Arctic Circumpolar Sub-region, from which two projections, the Atlantic Boreal and Pacific Boreal Sub-regions, pass southward to about lat. 40°. The Antarctic Pelagic Region consists of the Antarctic Sub-region, including the belt round the Antarctic continent, and the Notal Sub-region, which comprises the northern part of the Southern Ocean. The Atlantic Pelagic Region includes all the tropical and temperate parts of the Atlantic; the Indo-Pacific Pelagic Region includes the Indian Ocean and most of the Pacific. The second division comprises the coastal regions; they bound the Arctic and Antarctic Pelagic Regions, and include the belts of sea along the Atlantic, Pacific, and Indian Oceans;

these belts are reduced in size by long extensions of the Antarctic coastal regions along the western coasts of South America and South Africa, owing to cold Antarctic waters driven northward by the winds.

VI. ANIMALS AND PLANTS OF ECONOMIC IMPORTANCE

A. *Animals.*—The original distribution of domestic animals has been largely modified by man. He has taken with him in his wanderings those necessary for food, or as beasts of burden, or as companions. The chief animal foods, meat and milk, are supplied by cattle, which are now world-wide throughout the tropical and temperate zones. Sheep supply meat and wool, the most useful material for general clothing. The most valuable wool is that of the merino sheep, of which the original home was North Africa. Spain long held a monopoly of this breed, and maintained it by prohibition of the export of the live sheep. During the Spanish occupation of the Netherlands the merino was introduced through Holland into Saxony, which thus gained for a time pre-eminence in high-class wool. From Holland some merino sheep were taken to the Cape, but there deteriorated. The modern development of high-quality wool followed the introduction, after great difficulties only overcome by the Peninsular War, of some merino sheep into New South Wales, where by careful breeding the Australian sheep-farmers raised a wool combining the softness of the merino with the length of staple of the coarser British wools.

Goats' hair is used for clothing, as mohair, which is yielded by the Angora goats of Asia Minor, and as cashmere from those of North-Western India. Camels' hair is woven into carpets and strong textiles. The wool of the alpaca, which lives in South America, is especially soft and elastic.

Silk, a secretion from a caterpillar (*Bombyx*), was first cultivated in China, whence it spread to India, where the silk industry is partly maintained on the product of wild indigenous caterpillars, whose cocoons are collected in the woods. The silk-worm was also carried across Southern Asia to Europe. Its range in climate is controlled by that of its chief food-plant, the mulberry. Silk cultivation is most important among European countries in Italy, while France is the greatest silk-manufacturing country.

Of furs, the most valuable are those of the animals of the colder regions, as the sable and various foxes in Siberia, Northern Russia, and Canada; the ermine in the north temperate parts of Eurasia; the fur-seal in the North Pacific Ocean near Behring Strait. The largest quantities of furs are obtained from the small animals of

the north temperate zone, such as bear, squirrels, rabbits, hares, beavers, musquash, rats, cats, seals, &c. The southern forests of Australia yield the opossum.

Transport animals have been developed mainly in open grassy plains, where the rivers are not available for boats, and frequent migration is necessary in consequence of droughts and exhaustion of firewood. The steppes of Asia were probably the home of the horse and donkey, while the camel developed in the more arid regions of Asia and North Africa; oxen and buffalo are of most service for slow, heavy transport over bad roads, and yak among the mountains of Central Asia. In the Arctic regions the reindeer has been domesticated for transport, food, and fur.

The sea provides supplies of food-fish, which live at moderate depths mainly in the colder seas of the temperate zones. The chief fisheries are therefore in shallow seas or at banks which rise nearly to the surface, as around the British Isles, and especially in the North Sea, where the fishing-fleets of North-Western Europe compete for cod, herring, mackerel, and haddock, as well as for the scantier supplies of sole and turbot. The largest Atlantic fisheries are on the banks of Newfoundland, and off the coasts of Canada and the northern parts of the United States, where the chief fish are cod, herring, and hake.

In the warmer parts of the temperate zone the chief sea-fish are the sardine and the anchovy. Of shell-fish the most important is the oyster, which grows in estuaries on temperate coasts. Fish are abundant in the tropical seas, but their flesh is usually coarser. The most important freshwater fisheries are for salmon in the rivers of both sides of the North Atlantic and of Western Canada.

B. *Plants.*—In the tropics, owing to the heat and stimulus of the intense sunlight, plant growth, in the presence of ample moisture, is very rapid. Several harvests in the year may be reaped if the crops are supplied with water by irrigation, or by rain at suitable seasons. Owing to the heat, numerous products are developed, such as spices, rubber, oil, sugar, and starch, which are not produced, or only in smaller quantities, by the vegetation of colder climes. Hence modern civilization is dependent on the tropics for several essential materials. Cereals, on the other hand, which require slower growth and ripening, are characteristic of the temperate regions. The chief tropical and sub-tropical cereals are rice and dhurra.

The most valuable cereal is wheat, which thrives best under a cold wet spring and a hot dry summer; for when the plant is young, cold and wet increase the number of shoots, and

therefore the yield in grain for each seed, while the maturing and ripening of the grain require warm dry weather before the harvest. Hence countries with a Mediterranean distribution of rainfall are especially adapted for wheat cultivation. Southern Europe, owing to its hot summer, produces wheat of the best quality; Northern Europe, owing to the cold spring, produces heavier crops per acre, owing to the larger number of heads grown from a single seed.

Barley is of especial historical importance, as it was probably the first cereal cultivated by man, ears of it having been found in the ruins of the prehistoric pile-built lake villages of Switzerland. It has a wider range in climate than any other cereal, being grown in Norway as far north as 70° N. lat., while Northern Africa produces some of the most valuable, because the hard dry grains grown in its hot summer are of special value for brewing.

Oats are of service because they are easily cultivated, and can be raised in a colder and wetter climate than wheat.

Rye was formerly the most widely cultivated of European cereals, and is still the chief crop of Eastern Europe. It grows on poor soil, and has therefore been replaced by wheat or barley in Western Europe with the adoption of improved methods of agriculture.

Maize, or Indian corn, is the chief grain native to America; it is there known as corn, and thus its flour is used in Europe under the name of corn-flour. Its growth requires a hot summer and repeated watering from frequent summer rains or irrigation. It is therefore unsuited for most of Europe, as the British climate is too cold and the Mediterranean summer too dry.

Rice is the cereal which is claimed to give a higher yield of food per acre than any other crop. It grows under special conditions in the subtropical climates—in China, India, Burma, and the Eastern Archipelago. The rapid growth of the young plant requires the flooding of the rice-fields; hence, with the exception of hill rice, it is cultivated in irrigated deltas and river plains.

Of the fruits, many of the most useful, including apples, pears, plums, peaches, oranges, and lemons, have been developed from trees native to the warmer temperate regions. Figs are grown especially in the Eastern Mediterranean, but are only largely cultivated where there is plenty of cheap labour at the right season for drying and packing.

The vine is most prolific where, as in Southern Europe, the summer is long and warm, and the soil is dry; it flourishes as far south as Palestine, but no farther unless artificially sheltered from the summer heat. Grapes are most largely used

for wine, of which France is the greatest producing country. Raisins, sultanas, and currants are dried grapes grown from special varieties in South Europe, and particularly in the Grecian islands.

Sugar was primarily derived from sugar-cane, which was a native of South-Eastern Asia; it is now spread throughout the tropics and subtropical lowlands, and requires for its growth a high temperature and ample moisture. Its chief rival is beet, which produces large supplies of sugar in the temperate zone in France, Germany, and South-Western Russia. The mangel, a near ally of beetroot, is grown for cattle fodder in the warmer and drier parts of Southern England, where it is claimed that the beet may also be cultivated.

Spices, as a rule, require the heat of the tropics for the development of their aromatic constituents. Cloves and pepper come from islands like Zanzibar and Pemba, off Equatorial Africa; cinnamon from Ceylon; nutmegs, &c., from the Spice Islands of the Eastern Archipelago. Tobacco (*Nicotiana*) is a native of America, and has now spread throughout the subtropical countries; the United States is still the largest producer. Opium, extracted from the poppy, appears to have had its home in the eastern Mediterranean, where until recently the juice extracted from it contained the highest proportion of morphine. The most extensive cultivation of opium was in India, in the Ganges Valley, whence the product was largely exported to China for use as a narcotic; but by improvements in culture the Indian poppy has been grown richer in morphine, and the opium-fields are now producing that most helpful drug morphia.

Tea (*Camellia thea*) was first used and cultivated in China, but its original home was probably in Assam, where a tea tree still grows wild. It thrives best with warm summers and frequent rain, and can withstand severe frost. Its cultivation requires abundant cheap labour at the right time, and so the chief tea plantations are in China, Northern India, and Ceylon. Coffee appears to have come from South Abyssinia, whence it spread to Arabia; its growth requires a warm moist climate, for it can withstand neither severe frost nor excessive heat, and the young plants have to be protected from the sun under broad-leaved shelter plants. It is now most extensively grown in East Africa, Arabia, and Brazil. Cocoa (*Theobroma*) is the seed of an American tropical tree which supplies cocoa and chocolate, and is now largely cultivated in West Africa.

Of the vegetable fibres the most important for clothing is cotton (*Gossypium*), of which some species were indigenous to Europe and

others to America. It is essentially a subtropical plant requiring a moderate amount of moisture, but frost is fatal to it. The American supply comes mostly from the plains beside the Mississippi. The Nile delta in Egypt produces varieties of especial value from the length of the fibre. Cotton is largely grown on the lava plains of North-Western India, and although the quality produced is poor, its cultivation is cheap. Uganda, beside the Victoria Nyanza in Central Africa, is climatically well adapted for cotton, but is hampered by the limited transport available thence to the manufacturing districts of Lancashire and India.

Of the coarser fibre plants used for textiles, one of the most important is jute (*Corchorus*), of which the main cultivation is in North-Eastern Bengal on sandy plains flooded in the spring. It is mainly used for sacking and gunny bags, and for cheap carpets. As its fibre is lustrous, it is used to strengthen other fabrics, such as silk. Flax (*Linum*) grows under a wide range of climate, but requires a stiff moist soil. It is cultivated in North-Eastern Ireland; the main supply came from Russia, and it is now being largely grown in the highlands of tropical Africa. The stems of the plant provide the flax for linen, and the seed (linseed) yields a valuable oil. Of the fibres used for cordage and ropes, the most valuable grown in temperate regions is hemp. It is also woven into a strong fabric known, from the botanical name of the plant (*Cannabis*), as canvas. True hemp is mainly a temperate product, and the largest crops were grown in Russia and Italy. Manila hemp, which has a very long fibre, is obtained from the stem of a species of *Musa*, the banana. Sisal hemp is a long-stapled fibre obtained from the leaves of an aloe native to Central America; it is now largely cultivated in East Africa, and is especially used for binder twine, its adoption for ropes being limited by the belief that it deteriorates when exposed to sea-water.

Fabrics are rendered waterproof by india-rubber, a secretion of many tropical trees native to South America, Africa, and the Eastern Archipelago. It was first known in America, where it was used by the Indians to render fabrics waterproof; as it was used to remove pencil marks, it was known as india-rubber. The American supply is derived from *Hevea*, a tree found in the forests of the Amazon; and from *Manihot*, which yields the Ceara rubber of the coastal provinces of Brazil. The native African rubber comes from *Landolphia*, a vine growing in the forests of Equatorial Africa. Gutta-percha is derived from various trees, including *Dichopsis*, which live in South-Eastern Asia. Rubber as extracted is soft and elastic; it is hardened into vulcanite by combination with sulphur. Ebonite

consists of about equal parts of sulphur and rubber.

Timber includes two chief sections: light woods, which are soft and easily worked, and hard woods, which are stronger, heavier, and often take a good polish. The light-wood trees are mainly coniferous, such as the pines and firs, which grow in vast forests, especially in the colder temperate regions. In the warmer temperate zones cedars and other conifers grow in forests mixed with other trees. The light woods provide planks and beams for building construction, props to support the roof in mines, and pulp for paper manufacture. The hard woods grow in the temperate and tropical zones. The timber of the oak, elm, ash, beech, chestnut, and walnut provides strong durable woods suitable for building construction and shipping, tool-handles, furniture, &c. The tropical forests produce woods such as mahogany, which are especially prized owing to their beauty and hardness, while teak, from the forests of Burma and India, has the strength of oak, with the advantage that metals driven into it are less liable to rust. The forests of Australia produce woods which are hard, beautiful in grain, and heavier than water, such as the iron bark, karri, and jarrah, which, owing to their exceptional strength and heaviness, and resistance to decay in water, are used for piles and blocks for road-paving.

VII. THE DISTRIBUTION OF MINERALS¹

Minerals are the inorganic constituents of the earth, and they constitute the whole of its crust. The minerals first used by man were such stones as flint, which could be easily chipped into cutting-tools; those of chief present service may be classified into five groups. (1) The ores of metals, which were first required for weapons, tools, and ornaments, and are now used also for constructional work and currency. (2) Fuels, which are essential for smelting metals, for domestic supplies in large cities, and for illuminants. (3) The commoner and more abundant earthy minerals used in building construction, such as clays and loams for bricks and tiles, rocks and marbles for building-stone, slates for roofing, limestone for cements, and tough rocks for road-metal. (4) Scarcer minerals, such as graphite, mica, and talc, used for various industrial purposes, and gems, used on account of their hardness, optical properties, or beauty. (5) Minerals required by the agriculturist to fertilize exhausted or barren soils.

¹ The statistics quoted in this section are for the last pre-war year, 1913, as they probably indicate conditions to which there will be a tendency to recur, though doubtless some of the changes will be permanent, owing to movements which cannot be reversed, and to alterations in national boundaries.

The Metals.—Of the metals, that most essential to modern civilization is iron (which is now mostly employed in the form of steel). Rocks containing iron are world-wide in distribution, but only the richest are available as ores, since in the treatment of low-grade ores much of the labour and fuel spent in mining and smelting would be expended on useless material.

The present value of an ore depends upon its situation as well as upon its quality, for the possibility of its profitable use depends upon the proximity of the fuel and fluxes required in its smelting. Vast quantities of iron ores are known in places either so remote from markets or from fuel that they cannot be profitably worked at present. Sometimes, however, an ore with a low proportion of iron may be profitably used when its addition to a high-grade ore forms a suitable smelting-mixture.

Proximity to coal-fields and cheap transport largely determine the distribution of iron mining; the iron industry of the United Kingdom is mainly dependent on ores imported from the Mediterranean to ports on the British coal-fields. The use of the vast bodies of ore in Northern Scandinavia is restricted by their long distance from the coast, and by the presence in some of them of a considerable amount of titanium, the removal of which would be too costly in fuel. In 1913 the predominant iron- and steel-producing countries were the United States, with about 32 million tons; Germany, with 19 million tons; and the United Kingdom, with 9½ million tons.

The United States has the advantage of vast quantities of cheaply worked coal, and of the rich iron ores of Lake Superior. Germany had the rich coal-fields east of the Rhine, opposite the easily worked ironstone of Lorraine; in Great Britain the industry begun on native ores is maintained mainly on imported ores from Southern Europe.

Copper is of especial historical interest, for, being often found native and being easily wrought, it may have been the first metal used by man for tools and weapons. The subsequent discovery how to alloy it with tin into the more serviceable material bronze greatly increased its value. It is now chiefly used as the most convenient material for electric conductors, as wire, owing to its high ductility, and alloyed with zinc as brass, and with tin as bronze. Copper was at first worked in many countries of which the supplies cannot now compete with those of the chief copper-fields. Of the total world's production in 1913 of a million tons, the United States supplied more than half, or about 550,000 tons. The outputs in that year of the other chief copper-producing countries were: Japan, 72,000 tons; Spain and Portugal, mainly from

the ancient mines of Rio Tinto, 53,000 tons; Mexico, 52,000 tons; Australasia, 47,000 tons; Roumania, 43,000 tons; and Chile, which was once by far the leading copper-producing country, was seventh with 40,000 tons. The United Kingdom, in which the copper-mines were once important, yielded the negligible output of 300 tons.

Gold was one of the earliest metals used by man, for, though rare, it is conspicuous and attractive, and it is easily worked into ornaments of which the brilliant colour is not affected by rust or tarnish. The main use of gold is for money. In 1913, of a total output of 22 million ounces, the Transvaal supplied 40 per cent; the United States, 19 per cent; Australasia, 12 per cent; and Russia and Mexico each about 4 per cent; the other important contributions were from Canada, Rhodesia, and India. The British Empire, therefore, supplies by far the largest proportion of the gold output.

Silver is mainly worked as a by-product from ores of lead, and to a smaller extent from those of copper and gold. Its main uses are for ornaments, plate, jewellery, and currency. In 1913 Mexico was the largest producer with 82 million ounces; the United States was second with 67 million ounces; Canada third with nearly 32 million ounces; Australasia fourth with nearly 19 million ounces; and Germany fifth with 14 million ounces.

Lead is a useful metal, as it is easily melted, and is plastic when cold, so that it is convenient for small pipes which require to be bent; its weight renders it most suitable for shot; and it is the basis of some important alloys, as with tin in pewter and solder, and with antimony in type-metal. The world's output in 1913 was 1,130,000 tons, of which the United States supplied about one-third; Spain, one-fifth; Australasia, one-tenth; Mexico, one-twentieth; and the United Kingdom, one-thirtieth.

Tin, of the metals in common use, is the most sparse in distribution. It is indispensable as a constituent of bronze, for plating thin sheets of iron to save them from rust, and for lining cooking vessels to protect the food from being poisoned. The chief supply of tin from prehistoric times to the last century came from Cornwall, from which Britain gained its name of the Cassiterides, or Tin Islands. The Cornish mines were worked by the Phœnicians, who obtained there the tin for the bronze used by the people of the Eastern Mediterranean. The chief supply now comes from South-Eastern Asia. In 1913 the Strait Settlements yielded 36,000 tons; the Islands of Billiton and Banka, off Java, 18,000 tons; China, 3800 tons; and Australia, 5000 tons. The mines of England, Germany,

and Bolivia yielded small supplies, but since then the Cornish mines have closed.

Aluminium is of increasing importance owing to its lightness and non-liability to rust. It is a constituent of ordinary clay, but it can only be extracted profitably from one or two pure earths, of which the chief is bauxite. This ore is smelted in electric furnaces which require cheap water-power. In 1913 the United States was the chief producer of aluminium with 20,000 tons; France produced 15,000 tons; Great Britain, 10,000 tons; and Switzerland, 10,000 tons. The British works use bauxite imported from the south of France. Large supplies of bauxite occur in the tropics, in India, West Africa, and tropical America, as in British Guiana.

Zinc is of value as an alloy in brass, and for protecting metals from rust, as in galvanized sheets and wire. It is widely distributed, but its extraction as metal (known as spelter) is mainly undertaken, owing to difficulties in the process, in industrial centres far from the mining-fields. The Australian mines at Broken Hill in 1913 produced 525,000 tons of concentrated ore, which was mostly exported to Europe for the separation of the zinc. The United States is the largest producer. In 1913, of the world's output of about one million tons of zinc, the United States produced nearly one-third (323,000 tons); Germany, 285,000 tons; Belgium, 189,000 tons; and the United Kingdom, 59,000 tons. The zinc produced in the last three countries was mainly from imported ores.

Fuel.—The supreme fuel is coal, of which the only serious competitors are wood and oil. Wood is too bulky except for local use; it is too dangerous for railways in dry climates, owing to the discharge of sparks; and the supplies are too soon exhausted in a populous country. Oil is in some ways an ideal fuel, as it is clean, concentrated, and easy to handle; but the supply is inadequate to serve as the world's primary fuel. In 1913 the total coal output of the world amounted to nearly 1500 million tons; the total yield of oil is equivalent to about 100 million tons of coal, so that oil can replace coal only for special purposes. Coal is the common fossil fuel, and has mostly been formed by accumulations of fossil vegetation in some places where it had grown on the sites of former forests or peat-bogs, and where it had drifted into swamps or lakes. The layer of the plant material is then covered by sand or clay, and is slowly altered into coal by the combined effect of pressure and of slow chemical and biological changes.

Coal is the main fuel under present conditions, as it is the most convenient and safest of concentrated fuels. It is indispensable in iron manufacture, not only as a source of heat, but as the reducing agent necessary in the smelting of the

ores. Commercially, the coal-exporting countries enjoy the great benefit that the return steamers provide abundant freight for food and raw materials. Industries which require large quantities of coal usually settle either on the coal-fields or in places easy of access to them, owing to its bulkiness and brittleness. Coal has, therefore, been the most powerful factor in the distribution of industrial centres.

Great Britain was for a long time the leading coal-producing country of the world. In 1800 its mines provided two-thirds of the total supply; in 1860 it still yielded 60 per cent of the world's output; and it was not until 1899 that the United States, which have 353,000 sq. miles of coal-field in contrast to the 12,000 sq. miles in the British Isles, produced a larger output than Britain. The third great coal producer is Germany, which, with its pre-war boundaries, included larger reserves of coal than all the rest of Europe. In 1913 the United States produced 562 million tons, and Germany 278 million tons. The three countries, the United States, the United Kingdom, and Germany, together produced 87 per cent of the world's output. The remainder was mainly contributed by Austria and Hungary, 44 million tons; France, 42 million tons; Russia, 26 million tons; and India, 16 million tons. Australia has large coal-fields, but the demand on them is still relatively small.

China is believed to have larger reserves of coal than any other country; much of it is in areas still industrially undeveloped and far from the coast. China may, in centuries to come, be the world's great producer of coal.

In the British Isles the chief coal-fields are those of South Wales, with its outliers in Bristol and the Forest of Dean; Nottingham and South Yorkshire, with its recently proved great extension eastward; the Midland fields; Flintshire in North Wales; Northumberland and Durham; the Cumberland field, much of which is worked under the Irish Sea. The chief Scottish fields are in the Midland Valley of Scotland, especially in Lanarkshire and Ayrshire; the largest Scottish reserves are in Eastern Scotland, largely under the Firth of Forth.

Mineral Oil.—Petroleum (rock-oil) is the name given to a series of materials formed by the distillation of buried animal and vegetable matter under the influence of great pressure and long-continued moderate heat. This distillation produces four groups of materials: (1) natural gas and such volatile gases as petroleum-ether, which pass away as vapour at temperatures below 300° F.; (2) the illuminating oils such as kerosene and fuel oils, which are converted into vapour at temperatures of between 300° and 570° F.; (3) heavy oils used for lubricants; (4) the solid bitumens which occur in veins in rocks

or as sheets on the surface, as in the Pitch Lake of Trinidad; they are the residues from which the more volatile constituents have escaped by evaporation. Asphalt is a limestone containing a sufficient amount of bitumen to serve as natural paving-stone.

The most important supplies of mineral oil come from porous beds in which the oil has been naturally collected. The pressure of its included gas tends to force it upward, and it accumulates in any accessible porous rock, which then acts as a reservoir or oil-pool. The natural gas collects in the upper part of this reservoir; the oil lies below it, and usually rests on beds charged with water. If a bore-hole be drilled into such a reservoir the gas escapes first, then the oil, and finally the well will discharge only water. The chief supplies of mineral oil come from the United States, which in 1919 yielded 67·6 per cent of the total output; its fields are, however, believed to have reached or passed their maximum productiveness. Mexico is now yielding the second largest supply, and may for a time exceed the output from the United States. Other important oil-fields occur in Russia, Roumania, Burma, the Dutch East Indies, Persia, Egypt, and Trinidad. In addition to oil which has been naturally distilled and can be obtained directly from wells, large supplies may be obtained from oil-shale. This material consists of clay charged with organic matters which, when heated in retorts, is distilled into oil. The most important producing oil-shale field is in the Midland Valley of Scotland, between Edinburgh and Glasgow. Enormous reserves of oil-shale are known in other parts of the world, especially in the United States, Australia, the south-east of England, Canada, Burma, and Bulgaria; but their development has not hitherto been commercially possible in competition with the more cheaply produced native oil.

Cements and Fertilizers.—Two series of minerals of primary importance, as they are indispensable for dwellings and for the production of food, are those that yield cements and fertilizers. Most permanent buildings are constructed either of bricks, which are made by baking mixtures of clay and sand, or of building stones, which are quarried from beds or masses of rock, especially granite, basalt, limestone, and sandstone. The cements used to bind the bricks or stones in buildings are made by burning a mixture of limestone with clay or sand, which produces a powder that after the addition of water sets as a hard cement. The best known of the superior qualities is Portland cement, so called from its resemblance when set in mass to Portland stone. Its manufacture requires cheap fuel and local supplies of suitable limestone and silt. It was a British invention, but

in 1913 (the pre-war year), of the world's production of 200 million barrels (usually 380 lb. each), the United States produced about 46 per cent; Germany, 18 per cent; and Great Britain, 7·5 per cent.

Fertilizers are used in agriculture to replace the plant-foods extracted by the crops. The most important are phosphate and potash. The former consists of phosphate of lime, and is made from various phosphatic limestones; they are deposited in warm temperate and tropical seas. Some of these phosphatic limestones are old coral reefs which have been altered into phosphate of lime by phosphoric acid washed out of overlying beds of guano; some of them are beds of earthy limestone containing layers of phosphatic grains, which are due to the alteration of shells by phosphoric acid in sea-water.

Guano (q.v.) is a fertilizer formed by the accumulation of dung from sea-birds, bats, &c.

Potash is a necessary constituent for many plants, and the supply in soils can be renewed by potash salts, of which the largest known supplies are in Central and Southern Germany; they were deposited by evaporation of the waters of a great inland sea, and the quantity there is so vast that Germany long enjoyed a monopoly of potash production.

VIII. THE RACES OF MANKIND

The use made of the different regions of the earth depends on the character of the people who inhabit them. It is inevitable that the physical influences which have produced the striking contrast between the fauna and flora of Greenland and those of India should also have profoundly affected man. The hard struggle against Arctic conditions has had an impoverishing effect on both the physical and mental qualities of man as compared with those developed by the generosity of nature in the tropical zone. The main differences, however, between the inhabitants of different parts of the world are those based on race. South-Eastern Australia, Southern Europe, and subtropical America are generally alike in physical conditions; yet despite this similarity the Australian aborigines, the Europeans, and the American Indians have developed very different cultures. The classification of mankind is difficult, owing to the prolonged intermixture of the different races and the lack of constant and reliable characteristics. Efforts have been made to classify mankind on the basis of language; but unwritten languages change rapidly, and nations often impose their own on aliens or adopt those of their conquerors. Physical characters vary with change of climate and mode of life. Colour is the most conspicuous

physical feature, but it is clearly inconstant; a race becomes fairer in complexion by dwelling higher above sea-level, and darker by exposure to the tropical sun. The skull, which affords the most precise basis for comparison, appears to be easily modified by a change in national food and mode of life. Probably the least variable and most reliable characteristic for the major divisions is the nature of the hair.

Mankind is divided into three primary sections: (1) the Caucasian, a name now used in a purely conventional sense for most of the people of Europe, Northern Africa, and South-Western Asia, and for the settlers of European race in America, Australia, and South Africa; (2) the Mongolian, including the people of Central and South-Eastern Asia, the aboriginal tribes of America, and some European immigrants, such as the Lapps and Hungarians; (3) the Negro, including the natives of most of Africa, the Papuans, and Melanesians of the Eastern Archipelago.

The Caucasians have long wavy to straight hair, which is oval in cross-section; the colour of the skin is fair in the Northern Caucasians, but varies through brown to black in some of the mixed races of the Sudan; the lower jaw is in general not protruding; the eyes are large and straight, and vary from blue to black.

The Mongolian is characterized by coarse, lank, straight, dull-black hair, which is circular in cross-section; the face is beardless; the characteristic colour is yellow, but is coppery in the 'Red Indian' of America; the jaw is of medium size; the cheek bones are high; the eyes are placed obliquely, are slit-like in form, and black in colour.

The negro is characterized by having short frizzly to woolly hair, which is flat in cross-section; the colour of the skin is from black to brown; the lower jaw is massive and strongly protruding; the nose is broad and flat, with widely-open nostrils; the eyes are large and black.

The skull in each of the divisions varies from long to broad.

The Caucasian section is the most varied of the three. Huxley subdivided it into two, the White Caucasian or Xanthochroi, and the Black Caucasian or Melanochroi. Of the White Caucasians the inhabitants of North-Western Europe are of especial importance, owing to their world-wide political and industrial influence; they include three chief races. Northern Europe was the home of the tall, flaxen-haired, blue-eyed Nordic race, of whom the purest representatives at the present time live in Scandinavia; other members of this race are the Teutons of Northern Germany, the ancient Caledonians of Northern Scotland, the Anglo-Saxons, and the Normans

who migrated into the north of France from Scandinavia. From Southern Europe came the second race, the Mediterranean, which includes the Iberian or Celts who spread along the coasts of Western Europe in prehistoric times. They were short in stature, had long heads, and a dark complexion; they form the basis of the population of Portugal, Brittany, Cornwall, Wales, Ireland, and Western Scotland. Across Central Europe advanced the people of the Alpine race, who resembled those of the Mediterranean race in their short stature and dark complexion, but differed by being broad-headed. They entered from Asia, formed the basis of the Slav population of Eastern and Central Europe and of the East Prussians, and, spreading along the Alpine zone, occupied Switzerland, Southern Germany, Northern Italy, and Central France; and as the so-called Belgic tribes they formed the bulk of the population of England at the time of the Roman invasion.

The dark Caucasians, or Melanochroi, include the people of Southern Europe, the Semites of South-Western Asia, e.g. Jews and Arabs, the Hamites of North-Eastern Africa, such as the Egyptians, Somali, and Galla, and various mixed races due to intermarriage with negroes; most of the inhabitants of India; the Vedda of Ceylon; the Polynesian and Malay, and, therefore, also the people of Eastern Madagascar; also the aborigines of Australia, whose photographs, as has often been remarked, are strikingly similar to those of Europeans.

The typical Mongolians are the Chinese, Japanese, and Burmese; they include the Tartars, whose invasions as far west as Central Europe are marked by the occupation of part of the Danube basin by the Hungarians, and of parts of the Balkans by the Turks. A thousand years of European life has led to the Hungarian skull having become Europeanized, but the characteristic slit-like eye of the Mongolian is still conspicuous. Farther north, the westward advance of the Mongolians is represented by the presence of the Lapps, who have spread across Northern Russia into Northern Norway, and by the occupation of Finland by a Mongolo-Caucasian nation. Through North-Eastern Asia the Mongolians crossed to America, and the aboriginal people, or Indians, of both North and South America are a branch of the Mongolians.

The negro is the most distinct of the primary sections, and his distribution was the best defined. The original home of the negroes was probably in Africa, whence they spread to Western Madagascar, New Guinea or Papua, and the adjacent islands of Melanesia; thence in prehistoric times some members of this section spread southward to the east of Australia, and occupied Tasmania.

The range of the negro has been extended in modern times by their introduction as slaves into America and South-Western Europe.

IX. THE CENTRES OF POPULATION

Man doubtless at first lived in small family groups, which were widely scattered in order to draw on large areas for the scanty supplies of wild fruits and game. These families were in time forced to assemble in villages for protection against human enemies and wild animals. With the development of more civilized conditions, these village communities grew into towns in order to benefit by the specialized skill gained by workers in different industries, and for defence against robber gangs to whom the accumulated wealth was an attractive bait. As the towns increased in size, they and the land around them were organized into states, and towns especially favoured either by supplies of raw material or by position extended into cities. As internal communications improved, still larger areas were politically united, and the increase of trade led to the development of some of the cities into large administrative capitals. For example, in England the original hamlets of hunters and fishermen developed into villages and small towns; with the Roman occupation the need for an administrative capital led to the growth of London, owing to its position at the first easy crossing of the Thames, and its accessibility by boat from the Continent and by road from all parts of England. London, therefore, became the most important political, commercial, and manufacturing centre. Subsequently the transatlantic trade led to the growth of the western ports—Bristol for the south; Liverpool, which replaced Chester owing to the shallowness and shoaling of the Dee, for the Midlands; and Glasgow for Scotland. The abundant water-power in the Pennine valleys led to the settlement in western Yorkshire and Lancashire of the English textile industries, and subsequently the use of coal collected on or near the coal-fields all the chief iron-smelting and engineering works, the shipyards, and chemical and hardware factories. London continued to develop as the commercial capital, and as a great manufacturing city for the supply of the numerous requirements of a great administrative and world-trading centre.

The population of Great Britain is therefore densest around London and on the coal-fields. The concentration of the population near cheap coal and water transport is especially shown in Scotland, where the great bulk of the inhabitants live in the area around Glasgow, and each census shows a fall in the number of residents in some of the highland counties.

Throughout the world the population has been similarly controlled by the natural advantages of climate, soil, position, and mineral wealth. In countries in which man has retained his original conditions of nomad and hunter, the population remains sparse, and usually less than one to the square mile. Agriculture first rendered possible the aggregation of mankind into crowded communities. As rice produces more food per acre than any other crop, land suitable for its growth supports the densest agricultural populations, and vast areas of alluvial plains in China and North-Eastern India support over 400 people to the square mile. Still denser segregations occur in the great industrial and administrative centres which are maintained by exchange of commodities or by commercial or political tribute from the scattered areas with which they trade or which they administer. Thus London, the greatest city in the world, derives its wealth and food from world-wide sources. New York, the second largest city, serves as the chief port and commercial centre of the United States. Chicago is another colossal city, due to the coming together of the routes from the central states to pass the southern projection of the great lakes, or to reach the southernmost great port on Lake Michigan. A third type of concentration occurs on the coal-fields, which supply cheap power for the maintenance of many industries; they are usually distributed through numerous relatively small towns, which are maintained on the food received in exchange for their manufactures. Each of these three types of concentration has led to areas with populations of over 400 to the square mile. In areas of dense agricultural settlement the population is widespread, but they require markets and manufacturing centres.

The two countries with the densest industrial concentrations are England and Wales, with a population of 649 per square mile, and Belgium, which, owing to the wide distribution of its industries, has a population of 652 per square mile. In other states the population is most crowded in special areas, such as the Rhine Valley and Pennsylvania, owing to their prolific coal-fields; the north-western provinces of Italy, owing to the abundant water-power from the Alps; Bombay, where the cotton-mills are run by electricity generated by drainage from the adjacent mountains of the heavy monsoonal rainfall; and Java, with a dense population (675 per square mile) supported by the fertility of its volcanic soils, its abundant and well distributed rainfall, and the willing industry of its people.

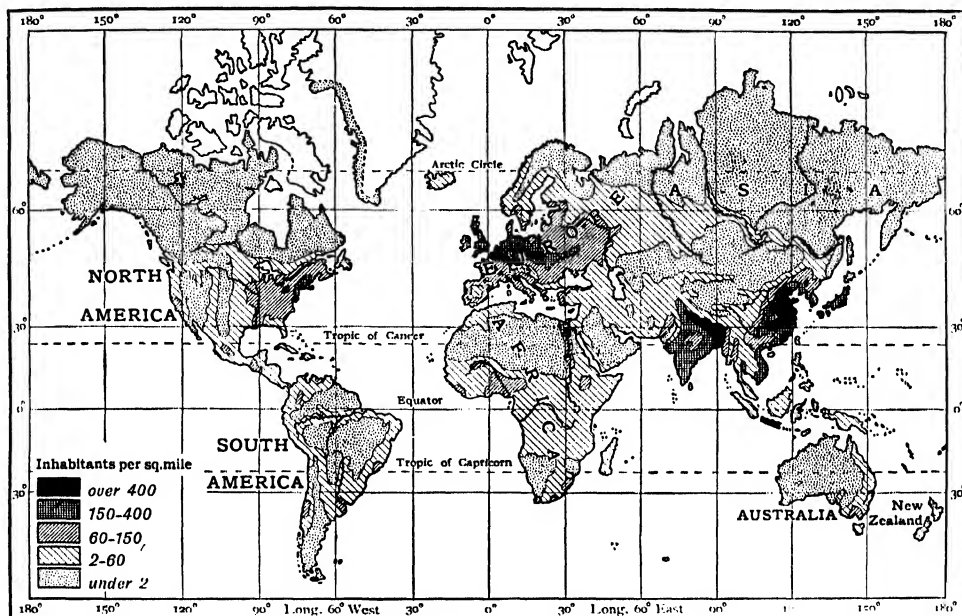
The second grade of density of population, containing from 150 to 400 inhabitants to the square mile, is found chiefly in areas suitable

for general agriculture, but for less intensive cultivation than the rice-lands. This grade covers most of India, Central China, and the Nile delta; in Europe it is found in Southern Germany and Austria, most of Italy, the north-west of Spain, Northern Portugal, and Eastern Ireland.

Areas of the third grade of population, that between 60 and 150 to the square mile, include most of the European Plain, exclusive of the industrial centres, such as the Rhine Valley, and

areas near the capital cities, such as around Rio de Janeiro, the coastland along the estuary of the La Plata, parts of Chile, and of the Magdalena Valley in the Republic of Colombia.

In Africa this grade is represented by Natal, owing to the development of sugar and other plantations by coolie labour; by Abyssinia, which, owing to the numbers of its people and strength of their hill country, is the only strong independent state on the continent; also by the coastlands of the Gulf of Guinea, owing to



The World: Density of Population

of the capitals, such as Petrograd, Berlin, and Moscow; the agricultural districts of North Germany, of most of Central and Southern Russia, have populations of this grade, which is reached also by Southern Sweden, owing to its sparse agricultural population being supplemented by those of the Baltic ports and of industrial towns maintained by the electric application of water-power. France, with the exception of the area around Paris, most of Spain, Hungary, and the Balkan Peninsula have the same density. This division includes in America the Mississippi Valley and the country between it and the Atlantic coast; in Western America only California; in Central America, Southern Mexico and parts of some adjacent states, owing to the fertility of their well-watered soils; in South America some small

the richness of their soil and the suitability of the crops produced there for development of the country by small holdings.

The areas which are least use to man and have less than two inhabitants to the square mile owe their sparse population to three chief causes. The severity of the winter in the northern plains restricts the population in Canada, Northern Europe, and Siberia. The opposite condition, the unmanageable exuberance of vegetation in the moist lowlands of the tropics, leads to the growth of impenetrable forest and jungle in which primitive people can live only as nomads and hunters, and thus causes the scanty population of the forests of the Amazon. The arid climate of the desert belt of the Old World, which extends across the Sahara, Arabia, and through Western Asia to Tibet and Mongolia,

and the desert condition of some south central parts of South America restricts the population, owing to the scarcity and uncertainty of the rainfall and the consequently precarious condition of the food-supply. The term desert is often restricted to areas relatively unpeopled, owing to the arid climate; but the older use of the word applied it to areas with a population sparse due to excessive wetness or severe cold; thus Sir Walter Scott speaks of the deserts of the Grampians, and the Bible references to desert places are to sparsely populated country districts in contrast to the villages and towns.

The great cities of the world include London, New York, and Chicago as the three greatest commercial centres; Paris and Berlin as the capitals of great European powers; Calcutta, Bombay, Canton, and Shanghai as the commercial centres of rich agricultural Asiatic areas; in the southern hemisphere the three greatest cities, Sydney, Melbourne, and Buenos Ayres, are growing fast with the agricultural and pastoral development of Australia and the Argentine.

The rise of the great capital cities is primarily due to their natural advantages of situation; but they may be maintained after changed circumstances have removed their original advantages; for the obstinacy and ingenuity of man often override natural advantages and drawbacks, and from habit and sentiment maintain a great city after the conditions which nurtured it have passed away. Countries do not always develop along the natural lines of progress; for "that Nature proposes and the resolution of man disposes is a fundamental principle in the study of applied geography".—BIBLIOGRAPHY: H. R. Mill, *The International Geography*; Stanford, *Compendium of Geography*; H. J. Mackinder, *Britain and the British Seas*; J. W. Gregory, *Geography: Structural, Physical, and Comparative*; J. Murray and J. Hjort, *The Depths of the Ocean*; C. R. Beazley, *The Dawn of Modern Geography*; G. G. Chisholm, *Commercial Geography*; J. McFarlane, *Economic Geography*; A. Stevens, *Applied Geography*; J. Bartholomew, *Atlas of Meteorology*, *Atlas of Zoogeography*.

Geok Tepe, a town and fortress of Central Asia, oasis of the Akhal-Tekke-Turkomans, long. 58° E., lat. 38° N. In 1879 the Russians under General Lomakine were defeated here with heavy loss, but in Jan., 1881, it was stormed by General Skobelev after a three weeks' siege, when about 8000 fugitives were massacred, no quarter being given.

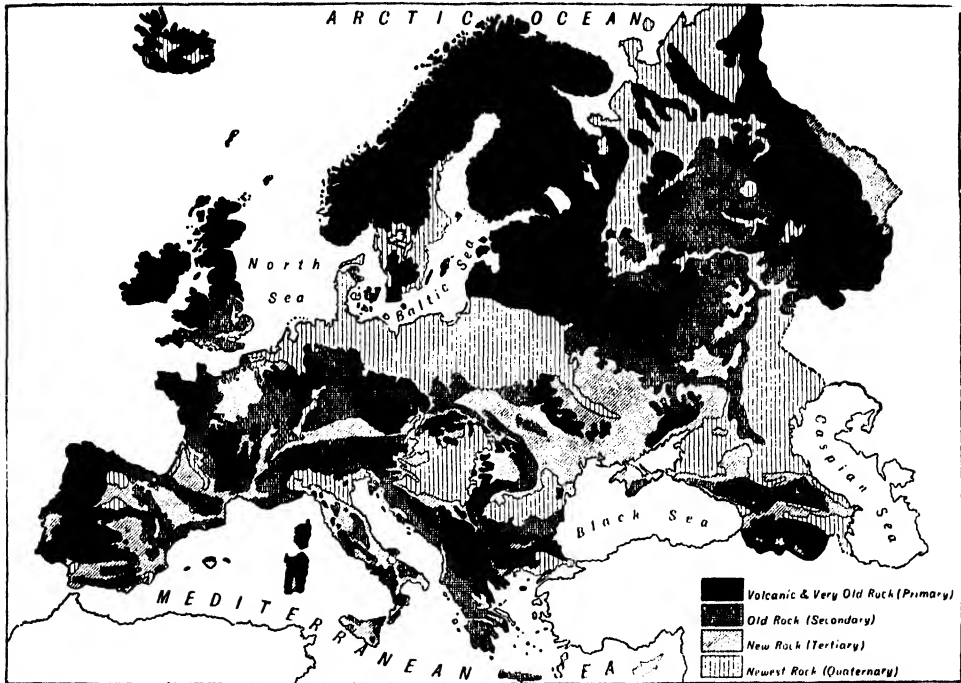
Geology (Gr. *gē*, the earth, and *logos*, a reasoned description) is the science concerned with the investigation of the structure and the past history of the earth, and of the causes that have brought about its present surface-features. The

relation of these features to the life of man may be left to the domain of geography, and the origin of the earth among other bodies in the universe to cosmogony, a subject that links geology with astronomy. The older geologists, in days when speculation went far beyond patient observation, were much attracted by cosmogony; and there is no doubt that any sound theory of planetary growth must be based on a knowledge not only of dynamical laws, but also of the mineral constitution of the globe. So large a volume of the globe, however, lies beyond the sphere of direct observation that the modern geologist contents himself with the ample field afforded by its outer skin or 'crust'. The crust of the earth may be defined as the region whose materials may be actually handled. Deep borings and mines provide vertical sections extending for little more than one mile of the four thousand that separate us from the centre of the earth; but the movements that have taken place in past times, and that are still in progress in the outer layers, have brought rocks from far greater depths within the reach of man. Some of the masses thus rendered accessible may at one time have lain fifteen or twenty miles below the surface.

The dawn of geological thought was no doubt stimulated by the activity of volcanoes, which were held to be a manifestation of internal fires fanned by subterranean wind. A wider field was opened by the observation of deposits containing marine shells far removed from the present margins of the sea. Xenophanes, a philosopher of the sixth century B.C., is credited by later writers with the assertion that these occurrences were due to an elevation of the ocean bed; and the fact that areas of sea and land had changed places was generally admitted by the naturalists of Græco-Roman schools. The literal interpretation of the Hebrew book of *Genesis* led to more restricted views, and marine fossils came to be regarded either as proofs of the Noachian deluge or as imitations of organic forms by some inherent moulding force within the earth. The revival of scientific thought during the Renaissance in the sixteenth century encouraged observation of the rocks themselves, and in Italy the marbles of the Alpine foot-hills, and the unconsolidated but uplifted strata on the fringes of the Apennines, alike provided material for writers whose devoutness could not be called in question. For three more centuries, however, the changes in the relations of land and water were generally attributed, with Burnet, to violent convulsions, rather than, with Aristotle, to processes that went on slowly in comparison with the span of human life.

The spectacle of an Alpine valley, with the edges of similar strata revealed on its precipitous and opposing walls, the huge blocks flung down into the ravine from cliffs that lie two miles apart upon the sky-line, the insignificance of the torrent that strives to find a way between them, these features suggested a catastrophic rifting of the earth. The magnitude of modern landslides seemed to provide local illustrations of a time when destructive forces prevailed over

battery of the sea may work its way across a continent. The agents now in action tend to reduce the land areas to the level of the sea; but the products of decay accumulate in the ocean basins and form the substance of new continents. The planing down of one area is followed or accompanied by the upheaval of another, so that the balance of nature is preserved and homes are continuously provided for living things. Hutton argued that sub-



Geological Map of Europe

those that mould and beautify the surface; the terrors of earthquakes in populous districts led to a belief in cataclysms that might have destroyed all life upon the globe. Abrupt obliteration and reconstruction seemed more in keeping with creative powers than an orderly process continued through immeasurable time; and when James Hutton, the Scottish philosopher, wrote his *Theory of the Earth* in 1785, his views were keenly contested even by his scientific colleagues.

Hutton urged the immense importance of the factor of time in allowing comparatively small forces to modify profoundly the surface-features of the earth. The swirl of a river may carve out a resonant ravine; the wash of rain may prevail against a range of crystalline rocks: the

terranean heat, on which he laid somewhat undue stress, is the cause of the consolidation of the sediments that are washed down from the land, and also of their ultimate upheaval. Primitive masses, such as granite, are brought up in the rising region, and some of this granite is molten and penetrates rocks of younger origin. This cycle of decay and reconstruction is repeated in the long history of the earth, and Hutton in consequence led the geologist away from speculations on cosmogony. Geology by itself gave no evidence of a beginning and no prospect of an end.

Though for a time the exponents of creative methods felt a certain disappointment in being called back to the realms of observation, the arguments of Hutton formed the basis of the

science of geology. They were expounded by his associate John Playfair, and expanded by Charles Lyell in his *Principles of Geology: being an attempt to explain the former changes of the earth's surface by reference to causes now in operation* (vol i, 1830). Contemporaneously, C. E. A. von Hoff, in Germany, maintained similar views in the face of considerable opposition.

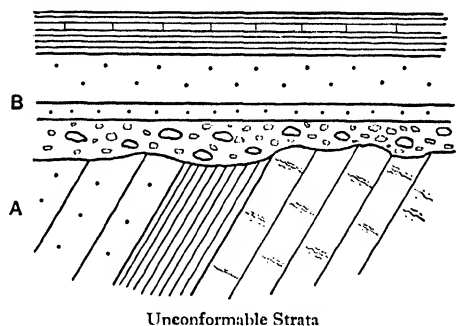
Meanwhile, William Smith had made one of the most far-reaching advances in the realm of science by showing, in his *Strata Identified by Organized Fossils* (1816), that the types of organisms entombed in rocks had varied by a regular sequence in geological time. Each fauna and flora was still generally held to be a special creation, suited to the times when it arose; but the similarity of the later faunas to that now prevalent on the earth, and the absolute extinction of many of the older forms, soon impressed itself on those who took up the growing science of *palaeontology*. An immensely wider interest was now attached to fossil organisms, and the way was open for the reception of a rational doctrine of descent.

Lyell, aided by the careful determinations of French and Italian colleagues, classified the more recent geological formations by the proportion of modern molluscan species that they contained. He was always ready to emphasize the imperfection of the record, and he pointed out the liability of the remains of mammals, birds, and land-animals in general to destruction; the rapid spread of *stratigraphical geology* in all parts of the earth confirmed the justice of his methods, and extended them to the whole history of living things. 'Geognostic' or mineral considerations no longer weighed with the stratigrapher. A study of the superposition of strata had revealed the true importance of their organic contents. *Petrology*, the science of rock-constitution and rock-origins, became for a time dwarfed by what may be called 'historical geology', and the problems presented by the crystalline and highly-altered masses underlying the first fossiliferous strata were left for a future generation.

Stratigraphical Geology.—Palaeontologists soon observed that the change from the older to the newer faunas was more gradual than was at first supposed. Though breaks of great importance might occur in any one locality, yet these could be filled by the study of strata that had been deposited in some other region. The breaks were seen to be due to a local change of conditions, whereby land had been formed, its surface had been denuded, and a long period had elapsed before a new deposition could take place. Commonly in such cases the older series of strata are uptilted and folded, and the later series have been laid down across their denuded edges.

Such a stratigraphical discordance is styled an *unconformity*. The time-interval represented by it may be enormous; but it does not record a general 'revolution of the globe'.

The publication of Charles Darwin's *Origin of Species* in 1859 gave a new meaning to palaeontology, and a new incentive to the discovery of faunas and floras that might reduce the imperfection of the record. The establishment of a cause for the variation of species, though it did not pretend to explain the vital force behind the variation, destroyed the individual importance of specific forms, and directed attention to descent. The pursuit of fossils was turned in a vertical direction across the horizons so well traced by William Smith. The extinct mammals of the Paris basin, reconstructed by Georges Cuvier, the fishes so systematically



studied by L. J. R. Agassiz, the shell-bearing cephalopods of L. von Buch, and the wealth of corals unfolded by Milne-Edwards and Haine, alike gained significance as parts of an impressive chain of animal forms. Though many of the variations, many of the by-ways, as it were, led ultimately to extinction, the minds of geologists were speedily captured by the sublimity of the sequence as a whole.

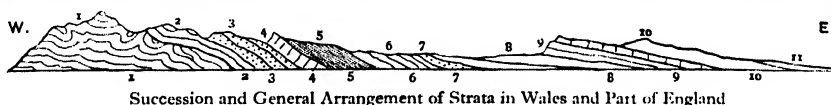
The search for the earliest forms of living things received a new stimulus; but it now seems that this search can never be rewarded. The preservation of animals or plants as fossils depends almost entirely on the possession of parts that can be mineralized or can resist decay. In exceptional circumstances moulds of soft-bodied creatures may remain, and casts of the digestive cavities of jelly-fish have been traced even in the earliest Cambrian strata; but beneath these strata very scanty relics, such as those found in Montana, fragments of crustacean carapaces, the tracks of worms, and a few traces of marine shells, alone testify to a fauna that already included a wide diversity of types. Beyond this, soft-bodied creatures, without protective covering, may have existed

through æons of earth-history. *Eozoon canadense*, described by J. Dawson in 1864 as a giant foraminifer from pre-Cambrian rocks, has proved to be a banded mineral structure, and palæontologists find no sure ground for study until the Olenellus-beds of the Cambrian system reveal a rich variety of invertebrate forms.

Following the principles of William Smith, geologists have divided the long range of fossiliferous rocks into *systems*, each system corresponding to a *period* of time bearing the same name. R. J. Murchison, by his work on *The Silurian System* (1839), familiarized this nomenclature at an early date. Adam Sedgwick was investigating contemporaneously what he styled

and has also been limited to the earlier section of these rocks. Perhaps the name Proterozoic is that which is most applicable to fossiliferous or possibly - fossiliferous pre-Cambrian strata. Then follows the Palæozoic or 'old life' group; then Mesozoic or 'middle life'; then Cainozoic or 'recent life'. Many authors prefer to start a fifth era, the Quaternary (the Ger. *Quartär* is more correct), for the beds formed since reasoning man (*Homo sapiens*) appeared upon the earth; but the closing of the Cainozoic era with the Pliocene system, though dating back to Lyell, seems a matter of sentiment rather than of logic or convenience.

Details of the systems will be found under



1, Cambrian and Ordovician. 2, Silurian. 3, Old Red Sandstone (Devonian). 4, Carboniferous Limestone (Carboniferous). 5, Coal Measures (Carboniferous). 6, Permian. 7, New Red Marl and Sandstone (Trias). 8, Lias. 9, Oolite. 10, Chalk, &c. (Cretaceous). 11, London Clay, &c. (Tertiary).

Cambrian strata in North Wales, and these two names will serve as examples of the way in which the terminology of the systems grew. The Silurian rocks are well revealed in the region once inhabited by the Silures; Cambria was the classic name for Wales. Other systems, such as the Carboniferous and the Cretaceous, were named less wisely from some prevalent type of rock. Charles Lyell found that he had a free hand with the later systems (*Principles of Geology*, vol iii, 1833), and he divided them according to the degree of resemblance of their molluscan species to those of recent seas. Hence each of the names terminates in 'cene', anglicized from the Gr. *kainos*, recent. The group including these systems is, however, spelt more correctly 'Cainozoic'.

The stratigraphical systems are marked by changes in the general fauna, and sometimes their establishment within certain limits has been influenced by the occurrence of an unconformity or a change in the type of deposit in the locality where the strata first received particular attention. The periods resemble those named in history after dynasties of kings, and by no means represent equal intervals of time. It has been convenient to bring them into five great 'eras', each corresponding to a 'group' of systems, and named from the degree of approximation of the general fauna to that prevalent at the present day. The term Azoic, 'devoid of life', has been used for the earliest rock-masses of the crust; but it is not safe to apply such a term to any stratified series. Archæan, implying high antiquity, has been used for rocks older than the Cambrian period,

their separate names in this *Encyclopedia*; but a general table may well be given here.

GROUP AND ERA.	SYSTEM AND PERIOD.
<i>Quaternary</i> .	Recent. Pleistocene.
<i>Cainozoic or Tertiary</i> .	Pliocene. Miocene. Oligocene. Eocene. Cretaceous.
<i>Mesozoic</i> .	Jurassic (sometimes divided in England into Oolitic and Liassic). Trias.
<i>Palæozoic</i> (newer sub-group).	Permian. Carboniferous. Devonian.
<i>Palæozoic</i> (older sub-group).	Gotlandian (or Silurian as now generally restricted). Ordovician (formerly Lower Silurian). Cambrian.
<i>Proterozoic or pre-Cambrian</i> .	(In the absence of satisfactory faunas, not divisible into systems.)

The subdivision of the systems and periods into *series* and *epochs*, and of these into *stages* (Fr. *étage*) and *ages*, can be effected locally, and it must be remembered that a marine stage in one country may be usefully represented by a freshwater or terrestrial in another.

Evidences as to changes of climate in past times are abundantly furnished by the study of strata. In this matter the rocks themselves are more convincing than the characters of the fauna, and the petrologist is here called to the aid of the stratigrapher. For instance, the gypsum and rock-salt beds of the British Trias indicate a region of desiccating lakes, and a granite surface etched by the sand-blasts of the desert has been unearthed at Charnwood

Forest. The 'millet-seed' sands of Lancashire and Cheshire show how the grains were rounded by wind-action, that is, by more frequent contact than occurs in water on a shore. The red iron hydroxide that colours many strata suggests a lacustrine or terrestrial origin; and the 'lateritic' zone in the basaltic series of North-Eastern Ireland, where aluminium hydroxide takes the place of the ordinary hydrous silicate kaolin as a product of rock-weathering in Oligocene times, shows that this weathering took place under conditions now prevailing in the tropics. During some epochs the fossil floras suggest that the climate over the whole earth was more uniform than now, and this point has often been raised in connection with the rapid spread and luxuriance of the Carboniferous forests. But it is probable that at all times the tilting of the earth's axis rendered the polar regions cooler than those nearer to the equator, and that the apparent uniformity of temperature was due to a general rise over the whole earth. A general cooling, on the other hand, is evidenced by the occurrence of *glacial epochs*, the lacustrine and terrestrial strata of which are boulder-clays, or their ancient consolidated representatives 'tillites'. The stones in these show characteristically smoothed and scratched surfaces, owing to their inclusion in moving glacier-ice. The rock-floor beneath these beds, whether the quartzite under the post-Pliocene boulder-clays of Connemara, or the dolerite under the Permian 'tillite' of the Cape Province, is frequently scored and polished and mamillated by the passage of ice-sheets over what was then the surface of the land. The occurrence of such evidence in the Permian strata of the tropics, coupled with the great extension of Himalayan and Andean glaciers during the post-Pliocene ice-age, shows that the refrigeration was by no means confined to polar regions. Many causes have been suggested for these world-wide climatic changes, and they form one of the most interesting subjects placed before the stratigraphical geologist.

Petrology.—The scientific description of rocks grew naturally out of the study of their mineral constituents, and this branch of geology, as its name suggests, has sometimes assumed the character of a separate science. It was largely developed by the treatises of mineralogists, and notably by R. J. Haüy (1801 and 1822) and Alex. Brongniart (1813 and 1827). A. G. Werner, professor at the School of Mines in Freiberg, Saxony, from 1775 to 1817, was inspiring as a mineralogist, but exercised a retarding influence on geology by his views on the nature of what are now known as igneous rocks. His own pupil, however, L. von Buch, was one of those who, by travel and field-observation, acquired

and spread sound views of rock-origins and rock-relations. The discovery by James Hutton, in Glen Tilt in 1785, of the intrusive character of granite put an end to the idea that rocks formed of crystalline silicates were necessarily older than all others in the district where they happened to occur. It became clear that, while such rocks consolidate far down within the crust, they may represent material molten during any geological period.

Independently of the cycle traced by Hutton, it was obvious that rocks could be broadly divided into (1) those once molten (*igneous*); (2) those formed by the deposition of the products of rock-decay and denudation (*sedimentary*, with a subdivision called *aqueous*, for rocks deposited in water); and (3) those in which considerable changes in structure, and often in mineral character, have taken place under earth-heat or earth-stresses or both. This third class is styled *metamorphic*.

If the earth was once molten as a whole, the igneous rocks form a primary and fundamental series, from which all others have been derived. Their manifestations in upper regions of the crust are due to their ascent into cracks or domes formed respectively by crust-torsion or folding, and this ascent may be due to the expansion of the gases that they contain, as well as to pressures exerted on the liquid stratum of which they form a part. As they rise, saturated with gases in an intensely-heated state, they may melt up considerable masses of the covering rocks, 'stoping' off abundant blocks by intruding into the cracks between them, and absorbing them as they sink into the depths. The cauldron containing the molten matter thus enlarges; if cracks open from it to the surface, volcanoes may arise, and these are largely hydrothermal phenomena—the upwelling of *lava* and the explosive action that gives rise to *tuffs* and comminuted *volcanic dust* are mostly the result of the expansion and passage into steam of the water previously confined in the igneous mass. Much of the dust, however, arises from the friction of coarser material in the air. Igneous rocks, then, are, after all, hot silicate solutions; but they are not, as Werner taught, laid down as sediments from the sea.

The age of an igneous rock is that of its last consolidation; it is clearly younger than the rocks into which it has intruded, forming in their cracks wall-like sheets or *dykes*; on the other hand, pebbles from it may be found in some overlying stratum. Maximum and minimum ages can be thus assigned to it. If it is obviously a lava-flow, its age is that of the beds associated with it. The material of the lava may represent primitive matter in the lower regions of the crust; but neither the lava nor

intrusive granite can be called a primitive rock.

In a masterly treatise, T. C. Chamberlin (*The Origin of the Earth*, 1916) has viewed the earth as formed of 'planetesimal' bodies aggregated in a solid form from space, and subsequently melted locally by heat developed during the contraction of the sphere, and by the accumulation of radio-active bodies near the surface. The differentiation of the more highly siliceous crust from a core consisting largely of iron alloyed with nickel went on slowly, and the igneous stratum that appears to underlie the crust may be the product of melting at a comparatively late epoch in the consolidation of the earth. R. A. Daly, on the other hand (*The Planetesimal Hypothesis*, in *Science Monthly*, 1920), maintains the general view that the earth was at one time molten as a whole, and that the igneous rocks rich in silica, such as granites, originated by gravitational separation towards the surface, while those less rich in silica, such as gabbros and basalts, now rise through them from considerable depths. None the less, remeltings must occur, and granites and highly crystalline rocks in general can no longer be regarded as necessarily very old.

In spite of artificial divisions that were at one time made on the continent of Europe between igneous rocks of Cainozoic and pre-Cainozoic age, we cannot trace any variation in the types of matter intruded or extruded since Proterozoic times. Any evolution that went on in the history of the molten mass of the earth occurred in the earliest ages. Within a deep-seated cauldron, however, various causes may bring about considerable mineral differentiation, and the tapping of the cauldron at one level or another may control the type of lava extruded at the surface.

Metamorphic rocks offer greater problems and present far wider variations. Some of the foliated masses known as *schists* are clearly sediments in which the minerals have developed along the bedding-planes under the influence of hot vapours streaming from some mass of igneous rock. In other cases, the intrusion of igneous matter along the bedding-planes, *lit par lit*, as French geologists have shown us, has produced a composite rock indistinguishable from the *banded gneisses* that were once regarded as a primordial type of sediment. Most schists, however, show signs of earth-pressure, and in some cases the essential structure, the foliation, whereby the minerals come to lie in planes parallel with one another, runs across indications of original bedding. Some of the felspathic and coarser metamorphic rocks, the *gneisses*, are clearly granitoid masses that have been partly crushed and caused to assume a solid flow. Again and again, however, the

pressure-schists may be traced into normal sedimentary series, or are associated with sedimentary bands that were incapable of assuming a schistose structure; while numerous areas of gneiss, once regarded as exposures of the primitive crust, have been found to display composite features. A. Lawson thus showed in 1887 that the 'Laurentian' granitoid rocks of Rainy Lake, in the pre-Cambrian region of Western Ontario, are intrusive in a schistose series, and the oldest rocks of Canada are now recognized, not in the Laurentian gneisses, but in the sedimentary Grenville beds. In region after region, from N. America to Finland, S. Africa, or Mysore, the foliated gneisses, long deemed to be fundamental, have been found to result from injection of igneous matter into some still older series. The foundation-stones of the accessible crust are sediments, and were formed by processes of denudation. Despite of all attempts to cast aside a rigid 'uniformitarian' dogma, the teaching of Hutton remains paramount—as far back as we can penetrate into the history of rocks, the processes that controlled their formation are those in operation at the present day.

Petrology, then, reveals no inspiring sequence corresponding to that of stratigraphical geology; but its study offers great attractions from the mineral and chemical point of view. P. L. A. Cordier in 1815, by examining the powdered rock with a microscope, proved that the apparently homogeneous ground of basalt was composed of minerals similar to those determinable in the rock-mass with the naked eye. C. G. Ehrenberg in 1839 prepared translucent sections of flints and limestones for his researches on minute organisms. A. Delesse applied the microscope with much success to the study of polished surfaces of igneous rocks. But it was not until H. C. Sorby in England in 1850 appreciated the value of thin sections that microscopical petrography began to enter on its ever-widening course.

Sorby's methods were adopted by F. Zirkel and H. Rosenbusch in Germany, and by F. Fouqué and Michel Lévy in France, and the observations of early workers in physics on the behaviour of minerals in polarized light were now utilized with great refinement for the determination of minute crystals in rocks. At the same time, the structures of rocks, and especially those due to various phases of cooling and to metamorphic deformation, became apparent with a delicacy that was regarded as almost finical by conservative workers in the field. Every geologist nowadays utilizes thin sections to fill in the details of his study of the ground itself, and microscopical observations go far in explaining the relative resistance

of rocks to decay, and thus have a bearing even on large features of the landscape. Micro-petrology in itself is a fascinating pursuit, and has greatly extended our knowledge of the characters of mineral species. As examples of its applications to geological philosophy, three finely-illustrated and pioneer works may be cited: F. Zirkel, *Microscopical Petrography* (United States Geological Survey of the 40th Parallel, 1877); Fouqué and Lévy, *Minéralogie micrographique* (1879); and J. J. H. Teall, *British Petrography* (1888).

Petrology involves a study of some of the grandest geological processes. The description of an igneous rock means little unless we view it as giving off its long-imprisoned gases in the crater of a volcano; or moving slowly down some slope, already devastated by centuries of outpouring, until the mesh of microscopic crystals gathers, at an appointed temperature, from the glass; or, again, as a reminder of the mobile matter beneath the solid crust, softening the strata until they yield and crumple, corroding them in the triumph of its advance, and then, by slow consolidation in some cauldron of the earth, fashioning the dominant masses of a future mountain-chain.

Sedimentary rocks are often looked on coldly, except from an economic point of view; but conglomerates suggest the rush of torrents, and the sudden floods that build up the plain with the detritus of parched and barren hills. Marine sediments mark ancient shore-lines, and their constituents provide a clue to the nature of the adjacent land. The irregular bedding of sandstones may suggest the wash of currents, and the nature of their cement may explain their jutting scarps along the hills. Limestones picture the sunlit surf on coral beaches, or the chill depths where white ooze gathers from a rain of protozoan shells. The soils, too long neglected, take their place as sedimentary rocks, and present all manner of physical and chemical problems, as we trace back the rich loams of the farm-lands to the crumbling surface of decay upon the moors.

Metamorphic rocks bring the geologist into near touch with the movements of the under-world, and the ovoid forms of crystals in a gneiss, surrounded by aureoles of dust worn from them, connect a thin section occupying four square centimetres with immeasurable regions of unrest and reconstruction.

Structural Geology.—The 'tectonics' of the earth have long appealed to miners, who are called on to trace valuable veins or deposits through a tangle of folds and across dislocating planes of fracture. The dislocations or *faults* probably drew early attention to the magnitude of earth-movements, and every gradation is now

known, from those sometimes seen in slates, where the vertical shift of the beds may be a fraction of an inch, to those the 'throw' of which is measurable in miles.

The fracture of strata is connected with tension or compression; the latter produces an over-riding of a bed by others from a lower series. The tilting of beds was recognized as a sign of earth-movement by N. Steno in 1668. The instability of the crust has always been

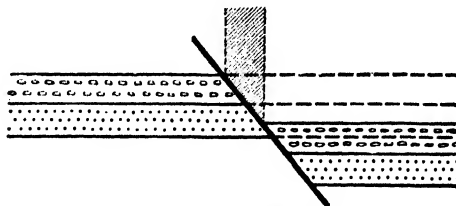


Diagram of a Normal Fault

The amount of stretching of the strata shown by the shaded area.

apparent through the occurrence of the tremors known as earthquakes; and in some cases these are accompanied by faulting visible at the surface. As C. Darwin noticed long ago, on the western coast of South America, large earth-movements may represent the sum of a number of successive steps. In 1809 the shore of Yakutat Bay in Alaska was raised by nearly 50 feet. Recent observations in the

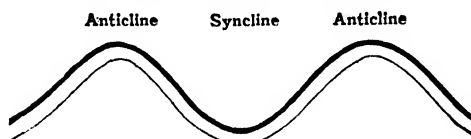
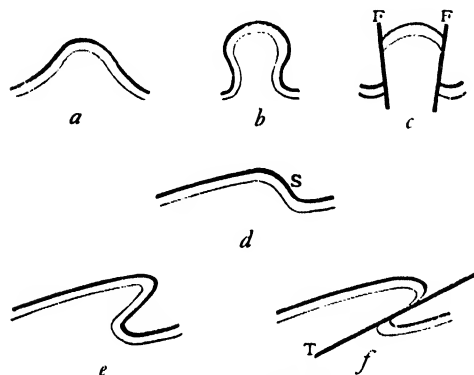


Diagram of Symmetrical Folds

coral-reef region of the Pacific tend to show that an ocean-floor sinks by breaking into blocks rather than by sagging downwards as a whole, and E. Suess has invoked faulting to account for upstanding masses, or *horsts*, which, in his view, owe their pre-eminence to the falling in of areas round them.

Movements of the crust are commonly accompanied by compression in certain regions, and by considerable crumpling of the stratified rocks involved. Linear mountain-chains, even when they resemble long arches, are the sum of numerous and complicated folds. The bending of strata into ridges, known as *anticlines*, and down-bent basins known as *synclines*, is frequently revealed in quarry-sections. An anticline is an elongated dome; a syncline is a spoon-shaped downfold; and in a contorted

region the sloping wall of an anticline is of course also that of the adjacent syncline. The tilted stratum is said to *dip* at such and such an angle to the horizon, and the direction of a horizontal line drawn on the surface of a bed is that of the general run or *strike* of the uptilted strata across the country. The strike of the gently-dipping Jurassic and Cretaceous systems in Central England is seen in the general direction of the escarpments of the Cotswold and the Chiltern Hills. In a crumpled district, dip and strike show marked variations in short distances; but even here the direction of the strike is a far more constant feature than the angle of the dip. There is a linear element in



a, b, c, Diagram illustrating the passage of a symmetrical fold into a faulted arch. d, e, f, Diagram illustrating the passage of an unsymmetrical fold, or monoclinical, into an overfold and an overthrust. S, Septum. F, Fault. T, Overthrust (after Marr).

folded mountains that suggests a connection with potential lines of fracture in the crust.

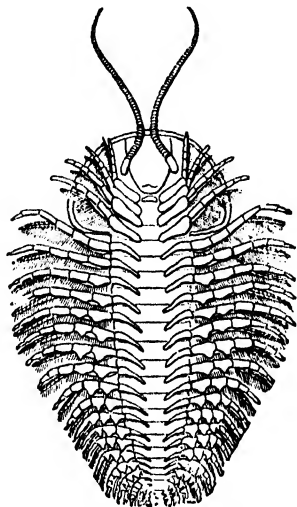
A series of anticlines may become pushed from one side and overfolded, until their limbs come to dip in the same direction. Further movement may force them over on one another, so that they resemble almost horizontal sheets. In these *recumbent folds* the succession of strata of course becomes reversed in the lower limbs of the anticlines, which are also the upper limbs of the synclines; careful mapping, and the sections seen on great valley-walls, alone enable the geologist to realize the true relations. An overfold may part in the middle, and its upper limb may progress along a *thrust-plane*, a fault of low angle to the horizon, until rock-masses are imported into a district ten or twenty miles from their place of origin. By successive overfolding and thrust-movement one sheet may follow on another. The study of the Alpine chains that were formed in Europe at the close of Miocene times has shown impressively how the final movements may be regarded as gravi-

tational, the upthrust masses falling forward upon younger and more yielding strata like the front of a breaking wave. The noses of the over-folded anticlines thus come to rest in a synclinal attitude among series that they have penetrated and displaced. Schardt, Bertrand, Termier, and Uhlig are among those who have developed these newer views of mountain-structure. A classic instance of the potency of thrust-planes occurs in north-western Scotland, where the pre-Cambrian 'eastern gneiss' has been piled upon fossiliferous strata now known to be of Cambrian age. The correct reading of the district was given by James Nicol as far back as 1856; but it required the detailed mapping of C. Lapworth in 1883 to convince geologists that a reversal had taken place in what seemed to be an orderly succession.

The doctrine of *isostasy*, put forward by Pratt in India and by Hayford in the United States, implies a general maintenance of equilibrium from the time that continents and oceans were established in Proterozoic times. Determinations of gravity with the pendulum show a gravity-excess beneath the oceans and a gravity-defect beneath uplifted masses of the land. It is inferred that the roots of mountains are formed of relatively light material, like that which is common at the surface, while denser matter has gathered beneath the ocean-floors. Hence a continent is maintained above the general level by lateral pressure underground. It floats in denser matter which its root-region has displaced. Denudation, however, carries matter, both in suspension and solution, from the continent to the ocean, and the lightened continent rises until the isostatic balance is restored. On this reasoning, elevated tracts are perpetuated; but we receive no help towards a rational theory of their origin. The movement of the outer crust has been generally ascribed to the contraction of the earth's interior and to the existence of a heated and mobile under-layer. It is probable, as O. Ampferer has urged, that weakenings of the crust by local meltings, and dragging movements in the under-layer, are responsible for ridging and overfolding at the surface. *Geosynclines*, great downward saggings, in which for long ages marine deposits have accumulated, often seem to have preceded *geanticlines*, or great upward bulgings, and this fact has led to theories of expansion by heating and increase in bulk by the injection of lava into clefts. No general relation, however, can yet be traced between folded chains and the regions in which they now occur. We still await an answer from the underworld.

Structural geology, then, brings us into touch with the large and lasting problems of the inanimate yet restless earth. We realize them

when a wave flows in across the denuded edges of upturned limestone on a shore, or when we trace in a worn and hummocked lowland the intrusions of granite into schists, the processes of absorption and reconstruction, that mark the



Trilobite (under side). A Palæozoic crustacean

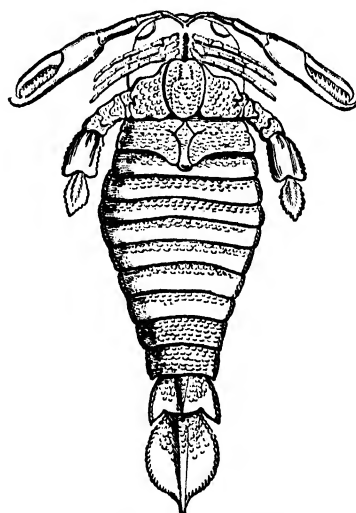
unstable base of a long-lost mountain-chain. The waste of the continents, by rain and rivers, by frost and glacial scour, is but a step in the process by which new continents are reared.

Palæontology.—The study of fossil remains is a branch of zoology and also of botany; but the biologist must bring to the work some knowledge of petrology, and of the fundamental facts by which we ascertain that one stratum is older than another. Despite the succession of faunas established by William Smith, the relative ages of stratified rocks cannot be proved by the arrangement of specimens in a supposed genetic sequence. As the literature of the Cambrian faunas in America shows, the hard facts of succession must be worked out in the field. But the palæontologist may justly claim that he has linked the strata one to another by a chain that emerges from the unknown past and leads onward to the unknown future, the golden chain of life.

This chain, like a rosary, has beads on it recording great and salient things; but it is not closed, and its two ends can never meet. We look back to the Cambrian period, and see a world in which primitive crustacea already existed, in which corals, brachiopods, and even specialized molluscs inhabited the sea, but in which browsing trilobites were the dominant forms of life. *Olenellus* of the Lower Cambrian

is about a decimetre long; *Paradoxides* of the Middle Cambrian measures at times 6 decimetres, say 2 feet. These were the largest animals of higher organization than the worms. The trilobites show in Ordovician times a rich variety that indicates a corresponding natural enterprise and vitality; but in the succeeding Gotlandian (Silurian) period their supremacy was threatened by great arachnids, the eurypterida, marine allies of the scorpions, while scorpions and even beetles appear upon the land. The limbs of the eurypterida are specialized in certain genera, not only as strong swimming paddles, but as deadly claws for securing prey. Side by side with them fishes appear, the first recorded vertebrates, many of them so quaint in type that a separate class has been proposed for them. Others lead onward to the sharks, a type so strong and so well armed that, with all its primitive skeletal features, it persists as the tyrant group of fishes in the seas to-day.

The occurrence in the northern hemisphere during Devonian times of a continental (Old Red Sandstone) type of deposit as well as marine strata enables us to know something of the nature of life upon the land. The flora of primitive forest types, ancestors of many lines of vegetation that have since become specialized and divergent, indicates how plants as well as animals have moved onwards in a

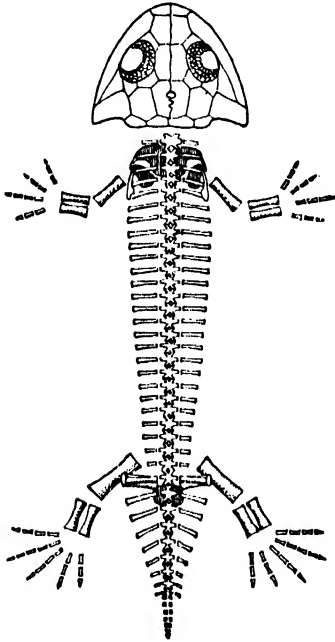


A Eurypterid (much reduced)

continuous chain of life. Fishes, in some cases protected by an armour of interlocked bony plates, in others bold and aggressive, and attaining a length of 30 feet, dominated the lakes and seas. *Dipterus*, a lung-fish, suggests the

possibility of vertebrates taking to the land, and footprints in the Old Red Sandstone of Connecticut probably record the first amphibians.

The amphibia head the vertebrate series in the Carboniferous period, moving amid the swamps and forests that laid the foundations of so many industries throughout the world; but in the Permian of Texas, Russia, and South Africa reptiles of varied types appear. The 'theromorphs' among them, like the calamites among Carboniferous trees, bear in their struc-



A Branchiosaur (restored). An amphibian of the Carboniferous period

tures the promise of far higher things. No modern reptile possesses the variety of teeth or the mammalian resemblances in skeletal details that occur in these transitional Permian forms. Both the amphibians and the reptiles adopted a bipedal attitude; they had no competitors, and could look out proudly on the world. The dinosaurs developed in the Trias, side by side with small mammals of humble and marsupial type. *Tritylodon* of South Africa seems to link the reptiles and the mammals. Throughout the whole Mesozoic era the mammals may have been cultivating craft and cunning, family devotion and the arts of self-preservation, but no prospect opened of their ever becoming the culminating race. The reptiles took to the ocean as swimming saurians 50 feet in length; they swept through the air on wings supported by an extended finger

of the hand; in bulky and often well-armoured forms they tramped about the land, at times 100 feet long and in many genera standing erect, assisted by their massive tails. Light forms lived in the trees, perhaps for safety, and from these, in Upper Jurassic times, the feathered race of birds arose, toothed like the reptiles, their bodies naked, far as yet from the strength of the eagle, nesting amid crag and cloud, and farther still from the fairy gleam of the humming-birds that suck the flowers.

In Cretaceous times swimming birds existed; but the pterosaurs, the flying reptiles, still held the kingdom of the air, while the dinosaurs showed no diminution in variety and vigour on the land. Our modern type of flora, with familiar genera of flowering trees, arose in the middle of the period.

And then, probably swept by some wind-borne or insect-borne bacterial disease, the whole empire of the reptiles crumbled. The mammals, that had been so long kept under, became heirs of land and water, and even, as delicate bats, essayed the air. The unspecialized *Phenacodus* of the Eocene leads on to the tapir, the rhinoceros, and the horse. Eocene whales are known, and lemurs foreshadow the ingenious race of apes. Though remains are scanty, the line of the primates hereafter forms one of the main attractions of palæontology. *Pliopithecus* of the Miocene is a gibbon; *Pithecanthropus* of the Pliocene is either an erect gibbon or a man. The oldest fossil attributable with certainty to man is the chinless jaw found near Heidelberg, deeply covered by Glacial deposits with remains of extinct mammalia. It has an important rival in *Eoanthropus* of the Piltdown gravels in Sussex, found in 1911. The spread of man was checked by the cold Glacial epoch of post-Pliocene times, and the climatic concentration of the human race may have led in some degree to social intercourse and to the more rapid development of the crowning acquisition, speech. Here the domain of palæontology closes, with brain-convolution dominant, and mere bulk vanquished in the fray. The future is yet for history to write, the history of this small upright mammal, now atavistically preying on his fellows like a rat, and now of so divine an apprehension that he would make the whole world round him a land of heart's desire. Geology, then, the science of the earth, links the growth and moulding of the globe with the great mystery of the origin and chain of life in time. It underlies all natural history, and leads from the strictly controlled field of mineral architecture to that of man's response to conscience, which is self-control.

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Geometrical Decorated, in architecture, applied to the earlier period of decorated Gothic, in which the tracery and other ornamentation consist entirely of distinct geometrical forms. See *Gothic Architecture*.

Geometrical Mean. Of any three successive terms of a geometrical progression the middle one is said to be the geometrical mean between the other two, and its value is equal to the square root of their product. It is the mean proportional between them. See next article.

Geometrical Progression, a series of numbers which increase or decrease by a common ratio: as 2, 6, 18, . . . or 100, 50, 25, . . . If a be the first term, r the common ratio, n any number of terms, then the n th term $= ar^{n-1}$, and the sum of n terms $= a(1 - r^n) \div (1 - r)$. If r be less than unity, the sum approaches the limit $a \div (1 - r)$ as n is increased indefinitely. A recurring decimal is an example of an infinite geometrical progression:

$$\cdot\dot{3} = \cdot3333 \dots = 3/10 + 3/10^2 + 3/10^3 \dots$$

Here $a = 3/10$, $r = 1/10$, so that $\cdot\dot{3} = a \div (1 - r) = \frac{1}{3}$.

Geometry, the branch of mathematics which deals with the properties of space. The subject is a vast one, and its boundaries are continually being extended, but the foundations laid by the Greeks still stand, and the student of to-day, like his predecessor of 2000 years ago, must begin with the facts which they discovered, and the problems which they solved. The science falls naturally into various divisions, according to the subjects treated and the methods employed. These divisions may be arranged in contrasted pairs, e.g. *plane* and *solid*; *plane* and *spherical*; *pure* or *synthetic* and *co-ordinate* or *analytical*; *metrical* and *projective*; *Euclidean* and *non-Euclidean*. Geometry is *plane*, *solid*, or *spherical*, according as it deals with figures in a plane, in space of three dimensions, or on the surface of a sphere. *Pure* geometry proceeds by deductive reasoning, and never loses sight of the figure; *analytical* geometry makes use of co-ordinates, and tends to become a branch of algebra. *Metical* geometry is concerned with measurements, such as those of length, area, and angle; *projective* geometry considers graphical properties not involving measurement, properties, e.g., relating to the intersection of lines, or the collinearity of points. *Descriptive geometry* deals with the representation of solid bodies by means of plane figures (see *Mechanical Drawing*).

Differential geometry applies the methods and ideas of the calculus to such properties of curves and surfaces as tangency and curvature; the name is also used in a more restricted sense for a method of dealing with surfaces (or other continua) which starts from the expression for the differential element of length on the surface in terms of the variables and their differentials; by this method the geometry of the surface is made to depend on measurements made on the surface itself, without reference to any space outside the surface. *Line geometry* deals with systems of straight lines in space. A line can be made to satisfy four conditions, passage through a given point counting for two. A system subject to one condition is called a *complex*; two conditions define a *congruence*, and three the lines of a *ruled surface*. The normals to a surface, e.g., form a congruence.

Elementary Geometry.—The first six books of Euclid, with the eleventh book, contain the substance of what is usually called elementary geometry. Euclid starts from certain *definitions*, *axioms*, and *postulates*, and from these derives the properties of figures by a process of pure deductive reasoning. Of the *definitions*, perhaps the most important is that of a straight line. Euclid describes this as the shortest distance between two points, but the definition he really uses (in Book I, proposition 4) is that "two straight lines cannot enclose a space"; in other words, a straight line is that kind of line which is determined when two points of it are known. Most of the *axioms* are simple principles of general logic, such as, "things that are equal to the same are equal to one another"; Euclid's enumeration of the principles of this type which he uses is by no means exhaustive. The twelfth axiom is the famous axiom of parallels. This is now generally replaced by one equivalent to it, introduced by Playfair, viz. that "two intersecting straight lines cannot both be parallel to the same straight line". For centuries mathematicians, among them some of the most eminent, such as Gauss, tried to prove the axiom of parallels. It is now known that these attempts were bound to fail. We can, in fact, point to a case in which all the other definitions, axioms, and postulates hold good, but the axiom of parallels does not. Let a spherical surface be divided in two by a plane through the centre, and let figures be confined to one of the hemispheres. Then, if we suppose Euclid's phrase 'straight line' to denote an arc of a great circle, all his reasoning and results, up to the point where the axiom of parallels is introduced, will still be valid. Euclid's *postulates* amount in effect to a specification of the instruments the use of which is to be allowed, viz. ruler and compasses. Thus, when it is said that the

problem of trisecting an angle cannot be solved by elementary geometry, what is meant is that in order to trisect an angle we need other instruments besides ruler and compasses. The *propositions* in the various books are of two classes, *problems* and *theorems*. In Book I constructions are given for bisecting an angle or a line, and for drawing a perpendicular to a line from any point. Among the theorems of Book I those dealing with the congruence of triangles are very important. It is shown that a triangle is determined if we are given: (a) two sides and the angle between them, or (b) three sides, or (c) two angles and a side, the side being definitely placed with respect to the angles. Proposition 32 is the characteristic theorem of Euclidean geometry, that the sum of the angles of a triangle is two right angles. Proposition 47 is the *theorem of Pythagoras*, that the square on the longest side of a right-angled triangle is equal to the sum of the squares on the other two sides. Book II deals with areas of squares and rectangles, the sides of which are connected by simple relations. The results are proved by actual construction and inspection of the rectangles and squares. From the modern point of view it is simpler to introduce the idea of the unit, so that lengths and areas can be represented by numbers; we can then prove the fundamental theorem of mensuration, that the area of a rectangle is the product of its length and breadth. The main theorems of Euclid's Book II are from this point of view equivalent to standard results in elementary algebra. A few of the theorems at the end of the book are more definitely geometrical. Propositions 12 and 13 are extensions of Pythagoras's Theorem, and are equivalent to the formula in trigonometry which gives the cosine of any angle of a triangle in terms of the sides. Proposition 14 solves the problem of constructing a square equal in area to a given rectilinear figure, this figure being first reduced to a rectangle by methods expounded in Book I. Book III is taken up with the properties of circles. Theorems that may be noted are that angles in the same segment of a circle are equal, and that the opposite angles of a quadrilateral inscribed in a circle are supplementary. A tangent to a circle is defined as a line which meets the circle but does not cut it, and it is proved that a tangent is at right angles to the radius to its point of contact. This definition of a tangent would not serve for curves in general, but it is sufficient for conics, and allows us to dispense with the difficult idea of a limit (see *Tangent*). Book III concludes with important propositions about rectangles under segments of chords. The main result is that if through a fixed point in the plane of a circle any line be drawn, then the product of the two intercepts between the point

and the circle has the same value for all directions of the line.

Book IV deals chiefly with the construction of regular polygons. With ruler and compasses an angle of 360° can be divided into 3, 4, or 5 equal parts. We can therefore find $\frac{1}{3} - \frac{1}{5}$ or $\frac{2}{15}$ of 360° , and, by halving this, divide 360° into 15 equal parts. Since, moreover, any angle can be bisected, it is possible to draw regular polygons of 3, 4, 5, 6, 8, 10, 12, or 15 sides, but not of 7, 9, 11, 13, or 14 sides. Gauss proved that a regular polygon can be constructed with Euclid's instruments when the number of sides is $2^n + 1$, where n is an integer, provided $2^n + 1$ is a prime. Taking $n = 4$, $n = 8$, we find that the construction is possible for 17 or 257 sides. Book V is a treatise on ratio. The modern method of dealing with the ratio of two magnitudes, which must be of the same kind, is to express them both by numbers in terms of a unit; their ratio is then defined to be the fraction which the one number is of the other. This method presupposes that the magnitudes are commensurable, i.e. that a unit can be found which is contained in each of the magnitudes a whole number of times. That this is not always the case the Greeks knew very well; the familiar example of the side and diagonal of a square was probably first given by Pythagoras. Euclid's method, considered as a theoretical discussion, is admirable; it applies whether the magnitudes are commensurable or not. For practical applications, however, we need a numerical specification of a ratio; in modern theory this is attained by introducing the irrational number, which for purposes of calculation can be represented by an ordinary rational number to as high a degree of approximation as we wish (see *Number*). Book VI deals with the properties of similar figures, i.e. figures which are equiangular, and have the sides about the equal angles proportionals, so that the one figure is simply a copy of the other on a reduced scale. (It is only in Euclidean geometry that such figures are possible.) A fundamental theorem is that a line parallel to the base of a triangle divides the sides proportionally. Various conditions sufficient for the similarity of two triangles are proved, these being analogous to the conditions for congruence given in Book I. It is proved that the areas of similar figures are in the ratio of the squares on a pair of corresponding sides. Books VII to IX deal with the properties of numbers, and Book X with incommensurable numbers; these books are not read now. Books XI, XII, and XIII deal with solid geometry; Book XI, propositions 1 to 21, with sometimes a few propositions of Book XII, are still read. Much of Book XI hangs on the definitions of a plane and of a line perpendicular to a plane. A plane is defined

to be a surface such that the straight line joining any two points in it lies wholly in the surface; a line is said to be perpendicular to a plane when it is perpendicular to every line which lies in the plane and which it meets. Euclid proves that a line perpendicular to two intersecting lines is perpendicular to the plane containing them; and shows how to draw a perpendicular to a plane from any given point.

Higher Geometry.—There is a considerable body of geometry, both ancient and modern, which may be regarded as simply a continuation of the elements, the subject matter and the methods being the same as those of Euclid. The theories of harmonic section, of pole and polar for a circle, of coaxial circles, and of centres of similitude, are examples. The 'Apollonian problem', to describe a circle to touch three given circles, with its many degenerate cases, was discussed by the Greek geometer Apollonius; a beautiful solution, which depends on the properties of radical axes, pole and polar, and centres of similitude, was given about 100 years ago by Gergonne.

Triangle Geometry is a special branch dealing with the properties of a triangle. It was much cultivated about the end of last century, and contains many pretty results. The Brocard points are the foci of the Brocard ellipse, an ellipse which is inscribed in the triangle, and has double contact with the circumcircle. The Tucker circles are circles having double contact with the Brocard ellipse, and belonging to the same system as the circumcircle. Many properties of the triangle have long been known, such as those relating to the circumscribed and inscribed circles, the centre of medians, the orthocentre, and the nine-points circle. Feuerbach's Theorem states that the nine-points circle touches the inscribed and the escribed circles; this theorem has been extended to the sphere by Hارت.

Geometrical Conics.—The conic sections may be defined to be the plane sections of a circular cone, right or oblique. The treatise on conics by Apollonius, which is based on this definition, is an astonishing example of the power with which the Greek geometers could handle their method. Nowadays it is usual, for the sake of simplicity, to start from other definitions of the conic. The method followed in the branch of geometry conventionally called *geometrical conics* is to define the conic as the locus of a point which moves in a plane so that its distance from a fixed point, called the *focus*, is in a constant ratio to its distance from a fixed line, called the *directrix* (see *Conic Sections*). The properties are then deduced by Euclid's methods. It is usual to define the tangent as the limiting position of a secant when one of its points of intersection with

the conic moves up to coincidence with the other. A good deal of the importance of the conic sections arises from the fact that the orbits of planets and comets are conics.

Projective Geometry.—Take any figure in a plane P (the *original plane*). Let Q be another plane (the *plane of projection*), and let O (the *centre of projection*) be a fixed point outside those planes. Straight lines drawn from O to all the points of the figure in plane P will cut

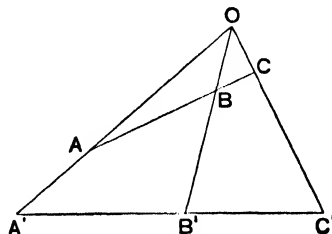


Fig. 1

the plane Q in a new figure, which is called the *projection* of the original figure. A straight line ABC in P will project into a straight line A'B'C' in Q (fig. 1), but lengths are altered; in general A'B' is not equal to AB, nor B'C' to BC; and the ratio A'B'/B'C' is not equal to AB/BC. Length of a line, and ratio of the segments of a line, are therefore said to be *non-projective*

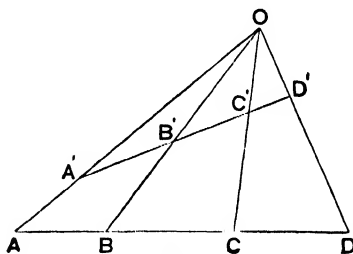


Fig. 2

properties. If, however, we take *four* points A, B, C, D (fig. 2) in a line, and if A', B', C', D' are the projections of these, then there is a relation between the segments of ABCD and those of A'B'C'D'. This relation may be put in various equivalent ways; one way is to say that the ratio of the two ratios AC : CB and AD : DB is not altered by projection; or, otherwise, that $(AC \cdot BD)/(AD \cdot BC)$ is not altered. This invariant fraction is called the *anharmonic ratio*, or the *cross-ratio* of the range of four points A, B, C, D. Points in a line form a *range*, and lines through a point form a *pencil* of lines. We have seen (fig. 2) that a pencil of four lines is cut by any *transversal* (crossing line) in a range

of constant cross-ratio; this is called the cross-ratio of the pencil. The order of the letters in the name of a segment is to be attended to; thus $DB = -BD$. When the cross-ratio is -1 , the points are said to form a harmonic range, of which A, B are one conjugate pair, and C, D the other. In this case C and D divide AB internally and externally in the same ratio. An important limiting case occurs when D goes to infinity. In this case $AD : DB = -1$, so that, if the range is harmonic, $AC : CB = 1$, or C is the middle point of AB. If A, B, C are three points in a line, we can find a fourth point D so as to make ABCD a harmonic range by the following construction (fig. 3). Take O any point outside ACB; join OA, OB, OC; in OC take any point G; let AG cut OB in E, and let BG cut OA in F. Then FE will cut AB in the required point D.

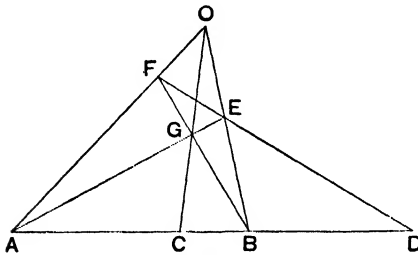


Fig. 3

It is remarkable that we get the same point D, however the points O and G are varied. This property of the figure, which can be deduced in a purely graphical way (without using the idea of distance at all) from solid geometry, or rather from the notions of plane, line, and point, has been used by von Staudt for the purpose of putting projective geometry on a basis quite independent of metrical considerations. In the projection of one figure into another, relations connected with parallelism are of special importance. Suppose we are projecting a figure in the plane P into a figure in the plane Q, from the vertex O. The plane through O parallel to Q will cut P in a line; this is called the *vanishing line* in the plane P. Obviously the line from O to any point in this vanishing line does not cut the plane Q. A line from O to a point in P very near the vanishing line would cut Q at a great distance; we are therefore led to say that a point in the vanishing line has its projection in Q at infinity. If we wish to retain, as quite generally true, the proposition that the projection of a line is a line, then we must say that the projection of the vanishing line is a line, or, in other words, the points at infinity in the plane Q lie in a line. This line is called the *line at infinity*

in the plane Q. By its introduction and systematic use, Euclidean geometry becomes more symmetrical, for we can now say that *any* pair of lines intersect in one point, parallel lines being lines intersecting at a point on the line at infinity. The introduction of the line infinity makes graphical Euclidean geometry projective, in the sense that *every* point projects into a point, and *every* line into a line. The method of projection often enables us to replace a figure by a simpler figure, and thus to give a simple proof of a proposed geometrical theorem. Take as an example the property that ABCD in fig. 3 is a harmonic range. (This is sometimes called the harmonic property of the complete quadrilateral, the quadrilateral being ABEF, completed by opposite pairs of sides being produced to meet at O and D.) Take OD for vanishing line, and any point V outside the plane ABO for centre of projection. In the projected figure O and D go to infinity, i.e. AFEF becomes a parallelogram and OC becomes a parallel to AF or BE through the centre of the parallelogram. Thus C', the projection of C, will be the mid point of A'B', the projection of AB. Hence A', C', B', with the point at infinity on A'B', form a harmonic range. Now project back to the original plane, keeping the same centre of projection. A', C', B', with the point at infinity on A'B', project into A, C, B, D; for the line at infinity in the plane of projection projects back into the line OD. But a harmonic range remains a harmonic range after projection; hence ABCD is a harmonic range.

Two lines which meet on the vanishing line project into parallel lines. With the right centre of projection we can therefore project any angle into an angle of assigned size α . By choosing centre and vanishing line properly, we can therefore project any line to infinity, and at the same time project any two angles into angles of given size. Any quadrilateral ABEF (fig. 3) may thus be projected into a square by projecting the line OD to infinity, and the angles BAF, AGF into right angles. A conic can be projected into a circle, and at the same time any line not intersecting it can be projected to infinity. Two conics intersecting in two real points, or in none, can be projected into circles. Projective methods are specially suitable for dealing with conics. The subject can be approached in many different ways, and can be treated independently of Euclid's metrical geometry. It is easier, however, for one acquainted with Euclid, to begin with the circle, to develop its projective properties, and to pass these on to the conic, assuming the conic to be defined as any projection of a circle, i.e. as any section of an (oblique) cone. One of the most important sections of the geometry of the circle

from this point of view is the theory of *pole and polar*. If O is a fixed point in the plane of the circle, OAD any chord through O , and M the harmonic conjugate of O with respect to A and D (i.e. if $OMAD$ is a harmonic range), then the locus of M is easily proved to be a straight line; this straight line is called the *polar* of O for the circle. If OBC is another chord through O , and if lines be drawn as in fig. 4, then the harmonic property of the quadrilateral (referred to above) shows that M and G lie on the polar of O , which is therefore the line $FMEG$. We have thus a purely graphical theorem which can be stated without any reference to harmonic section, viz. if OAD , OBC are chords of a circle through a fixed point O , then AC , BD , as also

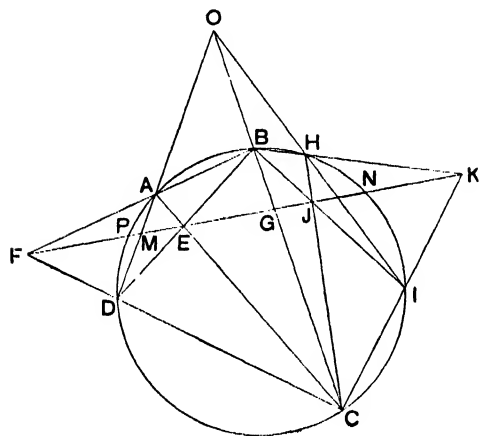


Fig. 4

AB , CD , intersect on a fixed line. If OHI is another chord, BI , CH , as well as BH , CI , also intersect on this line. If the polar EF of O meets the circle at P and N , then OP and ON are the tangents from O , so that these can be drawn with the ruler only, provided a drawing of the circle is actually given. In fig. 4 the triangle OEF is *self-polar* for the circle, i.e. each side is the polar of the opposite vertex, or, the same thing, each vertex is the *pole* of the opposite side. We see that if the polar of E passes through F , then the polar of F passes through E ; E and F are then said to be *conjugate points*. Similarly, EF and EO are said to be *conjugate lines*, the pole of each lying on the other. Since the theory of pole and polar is projective, it holds for any conic. The theory leads to an important method of transformation called the method of *reciprocal polars*, by which from any geometrical property we can deduce another, generally different, property. The transformation consists in replacing each straight line in

the figure by its pole, with respect to a fixed conic, and each line by its polar. The two figures are *reciprocal*, for the same transformation applied to the second figure would restore the first. Two very important reciprocal theorems are Pascal's and Brianchon's Theorems. Pascal's Theorem is: the three intersections of pairs of opposite sides of a hexagon inscribed in a conic lie in a line; and Brianchon's is: the lines joining opposite vertices of a hexagon described about a conic are concurrent. Pascal's Theorem leads to a very important method of defining, or generating, a conic as the locus of the intersections of corresponding lines (*rays*) of two homographic pencils; *homographic* pencils being such as have the cross-ratios of any four rays of the one pencil equal to the cross-ratio of a corresponding four in the other. The reciprocal theorem derives the conic as the envelope of (i.e. curve touching) the lines joining corresponding points of two homographic ranges. The derivation of all the properties of conics from these definitions is one of the most attractive chapters of geometrical theory.

Analytical, or Co-ordinate, Geometry.—In this branch of geometry a point is defined by co-ordinates (q.v.), and a line or curve by an *equation*, i.e. by a relation between the co-ordinates of any point on it. The equation of a straight line is of the first degree, i.e. of the form $ax+by+c=0$, so that there are two *constants* involved, viz. the ratios $a:b:c$. Specially useful forms are: (1) $y = mx + b$, where m is the *gradient* of the line, or tangent of the angle the line makes with Ox ; and b is the intercept the line makes on Oy . (2) $x \cos \alpha + y \sin \alpha = p$, where p is the perpendicular from the origin on the line, and α is the angle this perpendicular makes with Ox . Two lines are at right angles if the product of their gradients (mm') is -1 . The equation of the line through the two points (x_1, y_1) and (x_2, y_2) is $(x - x_1)/(x_1 - x_2) = (y - y_1)/(y_1 - y_2)$. The square of the distance between those two points is $(x_1 - x_2)^2 + (y_1 - y_2)^2$. The length of the perpendicular from (x', y') to the line $ax+by+c=0$ is $(ax' + by' + c)/\sqrt{a^2 + b^2}$. In proving these formulæ, the results of the ordinary Euclidean geometry are assumed. To illustrate the method of applying them, take the equation of a circle. If (x, y) is any point P on the circle, and if C the centre is (a, b) , the radius being c , then $PC^2 = c^2$, or $(x - a)^2 + (y - b)^2 = c^2$. This is a relation between the x and y of any point on the locus, and is therefore the equation of the locus. The equation is of the form $x^2 + y^2 + 2gx + 2fy + c = 0$. Comparing this with the most general equation of the second degree, viz. $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$, we see that (1) the term in xy is wanting, (2) the coefficients of x^2 and y^2 are equal. Conversely, any equation with these

features represents a circle, the centre and radius of which can easily be found when the equation is given. As an example, take the locus of a point P which moves so that $PA : PB = a$ constant, m say, where A and B are fixed points. We may choose the axes, to simplify the work, so that A is $(a, 0)$ and B is $(-a, 0)$. If P is (x, y) , we get $(x - a)^2 + y^2 = m^2\{(x + a)^2 + y^2\}$, or $(x^2 + y^2)(1 - m^2) - 2ax(1 + m^2) + a^2(1 - m^2) = 0$. From the form of this equation, the locus of P is a circle. The points of intersection of a line and curve are found by solving the equations of line and curve as simultaneous. The line $x \cos \alpha + y \sin \alpha = p$ will in general cut the circle $x^2 + y^2 = a^2$ in two points, for the simultaneous equations have two solutions. If $p = a$, the solutions coincide, and the line is a tangent; the common solution for $p = a$ being $(a \cos \alpha, a \sin \alpha)$, this is the point of contact. The line $xx' + yy' = a^2$ is therefore the tangent to $x^2 + y^2 = a^2$ at the point (x', y') on the circle. Suppose $P(x', y')$ is outside the circle. We can find the equation of the chord joining the points of contact of the tangents from P. For let $Q(x_1, y_1)$ and $R(x_2, y_2)$ be the points of contact. The tangents there are $xx_1 + yy_1 = a^2$ and $xx_2 + yy_2 = a^2$. These pass through (x', y') . Hence $x'x_1 + y'y_1 = a^2$ and $x'x_2 + y'y_2 = a^2$; these equations show that the line $x'x + y'y = a^2$ passes through Q and R; the equation of QR is therefore $x'x + y'y = a^2$. The properties of pole and polar can be deduced from this equation with great ease. The discussion of the properties of a curve is often simplified by expressing the co-ordinates of a point on the curve in terms of a single parameter. In the circle $x^2 + y^2 = a^2$, we may write $x = a \cos \theta$, $y = a \sin \theta$; in the parabola $y^2 = 4ax$, we put $x = am^2$, $y = 2am$; in the ellipse $x^2/a^2 + y^2/b^2 = 1$, $x = a \cos \theta$, $y = b \sin \theta$; θ and m being parameters. Analytical geometry is a subject of immense extent; the above sketch will give an idea of the nature of the processes followed. Other co-ordinates than Cartesian are often used, especially in more theoretical work. *Trilinear co-ordinates*, which are the perpendiculars from a point on the sides of a triangle of reference, are specially useful, as all equations may be written in homogeneous form, i.e. with every term of the same degree.

Non-Euclidean Geometry.—A great deal of geometry is independent of the idea of *distance*. Suppose that we think of a point simply as something represented by a combination of two numbers (x, y) , or of the ratios of three numbers x, y, z ; and that we define a line as the locus of points satisfying a homogeneous equation of the first degree in x, y, z ; then the whole of projective geometry follows algebraically. How are we now to introduce the idea of distance into this scheme? It was shown by Cayley that the

distance of two points may be regarded as a projective relationship of the two points to a fixed conic, which he called the *Absolute*. If we suppose the absolute to be a real conic, and if the line through P and Q cuts the absolute in E and F, then the distance PQ can be defined as a constant multiple of the logarithm of the cross-ratio $(EQ/QF)/(EP/PF)$. If, as a special case, we take for the absolute a circle with centre at a fixed point, and if we suppose the radius R of the circle to increase indefinitely, then it is easy to show that the limiting value of $\frac{1}{2}R$ multiplied by the logarithm of the above cross-ratio is the ordinary Euclidean distance. Angles are measured in a similar way by the logarithm of the cross-ratio of the pencil formed by the two lines and the two tangents to the absolute from their point of intersection. In the limiting case just mentioned, the two tangents would be the lines from the angular point to the circular points at infinity, i.e. the two imaginary points through which all circles pass, and at which every circle touches its asymptotes. Euclidean geometry is thus a degenerate case of Cayley's non-Euclidean geometry, the absolute having degenerated to an infinite circle; from a slightly different point of view, to a conic which, regarded as a locus, consists of the line at infinity taken twice over; and, regarded as an envelope, is the envelope of all lines passing through the two circular points. Perpendicular lines are lines which are conjugate with respect to the absolute. In the Euclidean case, perpendicular lines therefore form a harmonic pencil with the lines from their intersection to the circular points. In Cayley's geometry, a circle, i.e. the locus of a point at a fixed distance from a given point, is a conic having double contact with the absolute; most of the properties of ordinary circles can be extended to this generalized case. A non-Euclidean geometry of a different type was invented by Riemann, who founded his work on the methods applied by Gauss to the theory of surfaces. Instead of dealing with the distance of two points separated by any finite interval, he considered the distance of a point from points in its immediate neighbourhood. Every point in a continuum (e.g. curve, surface, solid space) is specified by co-ordinates; on a surface a point has two of these, in a solid space three. The co-ordinates are not defined geometrically; they are mere numbers chosen for the purpose of identifying points. On a surface, e.g., two systems of curves may be drawn; the curves of one system have numbers 1, 2, 3, 4, &c., attached to them; so have the curves of the other system; the point where the curve numbered p in the first system intersects the curve numbered q in the second is the point (p, q) . Two points close to each other are supposed to be at a certain

definite distance, which remains unaltered however its expression in terms of the co-ordinates may change. If dp , dq are the differentials of p and q , and ds the corresponding elementary distance, then we have a formula $ds^2 = Adp^2 + Bdpdq + Cdq^2$, where A , B , C are functions of p and q . The geometry of the surface is characterized by the functions A , B , C . All intrinsic relations in the surface, such as those connected with curvature, and with geodesics, or shortest lines, can be expressed in terms of these functions; we do not need to consider anything outside the surface. A certain function of A , B , C must vanish if it is possible to choose co-ordinates x , y such that ds^2 can be expressed in the form $dx^2 + dy^2$; the vanishing of this function is the condition that the geometry of the surface should be the same as that of a Euclidean plane surface. On a circular cylinder, e.g. if (a, z, ϕ) are the cylindrical co-ordinates of a point, we have $ds^2 = dz^2 + a^2 d\phi^2$; by putting $z = x$, $a\phi = y$, this becomes $ds^2 = dx^2 + dy^2$. The geometry is therefore Euclidean, as is otherwise obvious, since the surface may be developed into a plane, without rumpling or tearing, and therefore without altering differential distances; and without altering finite distances, if these be measured on the surface along a geodesic. A question asked by Gauss and Riemann was: Is our space of three dimensions necessarily Euclidean? Riemann investigated the most general form for ds^2 consistent with the property that bodies can be moved about in space without change of size or shape, i.e. consistent with congruence relations being possible. He found the form $ds^2 = (dx^2 + dy^2 + dz^2)/N^2$, where $N = 1 + \frac{1}{2}\alpha(x^2 + y^2 + z^2)$, α being a constant, which may be called the curvature of space. Euclidean space corresponds to $\alpha = 0$. If α is negative, the geometry is called hyperbolic; this corresponds to the system invented for plane geometry by Lobatchewsky. If α is positive, space is finite, though unbounded, and every straight line is closed. Gauss at one time thought of measuring the angles of the triangle formed by three mountain peaks, and testing whether their sum was greater than, equal to, or less than two right angles. Assuming that light travels along a geodesic in space, and that the experiment could be carried out with sufficient refinement, this would settle the matter; for Gauss has shown that, in a triangle ABC , formed by geodesic lines, the ratio of $A + B + C - \pi$ to the area of the triangle measures the curvature of space, i.e. the number α already mentioned. The relation between the geometries of Riemann and Cayley was worked out by Klein. If we discard free mobility, or the possibility of congruence, we can have a space of a much more general character, such as that postulated by Einstein in his

General Theory of Relativity.—BIBLIOGRAPHY: editions of Euclid's *Elements*, by J. S. Mackay, and by Hall and Stevens; J. Casey, *Sequel to Euclid*; J. W. Russell, *Pure Geometry*; L. B. Benny, *Plane Geometry* (a treatise on projective and analytical geometry, giving a full account of conics from various points of view); C. Smith, *Conic Sections* (analytical); G. Salmon, *Conic Sections* (analytical); R. Bell, *Co-ordinate Geometry of Three Dimensions*; J. L. Coolidge, *Non-Euclidean Geometry*; H. S. Carslaw, *Non-Euclidean Geometry*; A. N. Whitehead, *The Axioms of Projective Geometry*.

Geometry, History of. The origin of geometry is assigned by an ancient tradition to Egypt, but the history of the science, as far as it is known, commences in Greece with Thales (639–548 B.C.), who in conjunction with Anaximander founded the Ionic school. The most famous representative of this school was Pythagoras (582–500 B.C.), who with his associates, called Pythagoreans, made geometry a science by basing it on axioms, postulates, and definitions, and formulating methods of proof. They combined arithmetic with geometry, and investigated the properties of areas and volumes. The discovery of the relation between the squares on the sides of a right-angled triangle is attributed to Pythagoras, and he is also said to have been the first to prove that the circle contains a greater area than any plane figure having the same perimeter, and that the sphere contains the greatest volume bounded by a given surface.

Later Hippocrates of Chios, Theodsius of Cyrene, and Archytas of Tarentum made important discoveries, but the next great development of the science is due to the school of Plato. The Platonists added to the Pythagorean geometry the properties of the regular solids and of the cone, prism, and cylinder; they also developed the fundamental principles of geometrical loci. Euclid, who was born shortly after Plato, is probably the best known of all the ancient geometers. His *Elements* is the most famous treatise on geometry ever written. Although abandoned as a textbook on the Continent more than a hundred years ago, it continued to be the chief school-book on geometry used in the British Isles until the beginning of this century. In Euclid's *Elements* all the more important problems and theorems worked out by his predecessors are collected, systematized, and arranged in logical order. He wrote many other mathematical works—a book of data, a treatise of porisms, &c., most of which have been lost.

After Euclid came Archimedes (287–212 B.C.), the greatest scientist of ancient times, among whose works are treatises on spheres, conoids and spheroids, and spirals. He investigated the relations between the circumference, diameter,

and area of a circle, found the surface and volume of a sphere and of a spherical segment, and proved that the area of a segment of a parabola cut off by a double ordinate is two-thirds of the parallelogram that encloses it. Apollonius (about 250 B.C.) wrote eight books on conics, considered as sections of the cone, and proved most of the properties which relate to their foci, tangents, asymptotes, and diameters. Apollonius was followed by Nicomedes, the inventor of the conchoid; Diocles, who invented the cissoid; Hipparchus, who was one of the first to develop trigonometry; and Heron. In the early part of the Christian era, Menelaus propounded his theorem on the segments of the sides of a triangle cut off by a straight line, a theorem which centuries afterwards led to the theory of transversals.

Ptolemy (A.D. 125) was responsible for many important researches; and the commentator Pappus (390), in addition to editing many of the researches of his predecessors, discovered an important case of Pascal's Theorem, and two well-known theorems on centres of inertia.

Diophantus, in the third century A.D., introduced methods of an algebraic kind, and may be said to be the connecting link between the ancient and modern geometers, the geometry of the Arabs, of Leonard of Pisa, Cardan, and, Vieta being based upon his methods. After the sack of Alexandria, scarcely any progress was made until the sixteenth century. The Romans had no liking for the subject, but the Hindus and Arabs gave it some attention. Vieta (1540-1603) used algebraic symbols for the solution of geometrical problems, and is said to have discovered many of the formulae of trigonometry. Kepler (1571-1630) introduced the principle of geometrical continuity, and developed Archimedes' method of exhaustions on simpler lines than those of the Greeks.

Cavalieri (died 1647) discovered the method of quadratures; Descartes (1596-1650), by his invention of the method of co-ordinates, immensely extended the domain of geometrical science; Desargues and Pascal were the pioneers of modern geometry. About this time, however, attention was concentrated on fluxions and the infinitesimal calculus.

Fermat (1601-65) and Barrow (1630-77) with their methods of tangents and maxima, Huyghens (1629-95) with the theory of involutes, Roberval, Pascal, and Wallis with their processes of summation, were on the way to the calculus, which was finally established by the genius of Newton (1642-1727), although Leibnitz, who was working on different lines, disputed the claim of Newton to be the discoverer.

The study of geometry revived at the beginning of the nineteenth century under Monge (1746-

1818) and Carnot (1753-1823). Monge invented the method of descriptive geometry, and established the theory of projections; Carnot contributed the theory of transversals. Poncelet introduced many new ideas, and is entitled to be called the founder of projective geometry. In Germany, Möbius, Plücker, and Steiner made notable advances. Chasles, in France, and Maceullagh, in Ireland, gave examples of the power and beauty of geometrical, as contrasted with analytical, methods. Projective geometry was placed on a basis independent of metrical considerations by von Staudt. Analytical geometry was enriched by applications of the method of invariants, developed especially by Cayley, Sylvester, Salmon, Aronhold, Hesse, and Clebsch. Sir William Rowan Hamilton invented quaternions, and Grassman applied to geometry a somewhat similar non-commutative algebra. For centuries Euclid's axiom of parallels was the crux of geometry. The idea of dispensing with the axiom altogether is due to Bolyai and Lobatchewsky, who, with Gauss, Riemann, Clifford, Beltrami, Cayley, and Klein, have founded non-Euclidean geometry, interest in which has been greatly stimulated by the recent development of the theory of relativity. The logical foundations of the whole science of geometry have within recent years been searchingly criticized. Helmholtz and Lie analysed the idea of congruence, and investigated conditions for its possibility. Systems of axioms have been elaborated by Peano, Pieri, Hilbert, Whitehead, Veblen, and others, the object being to reach the irreducible minimum of assumption on which a geometry can be founded. One interesting effect of these various modern developments has been to emphasize the sharp distinction between abstract geometry, a purely ideal construction, and physical geometry, or the geometry of the world as it actually exists. Probably no philosopher would now maintain the view, at one time practically universal, that geometry is one of the subjects in which a priori knowledge is possible.

Geophagism (Gr. *gē*, earth, and *phagein*, to eat), or **Earth-eating**, the practice of eating some kind of earthy matter, clay, chalk, &c., common amongst uncivilized peoples, such as the South American Ottomacs, the Indians of the Hudson Bay country, the West Indian blacks, the negroes in some of the United States of America, and others. In some cases it is probably done to allay hunger, but it is also practised where the supply of food is sufficient. Amongst chlorotic young women a similarly depraved appetite is not uncommon. Geophagism causes death by dropsy or dysentery.

Geoponici (Gr. *Geopontikoi*), a term employed to designate the Greek and Roman writers on

agriculture, the Latin term being *Scriptores Rei Rusticæ*. The ancient Greeks devoted their attention to the scientific study of agriculture, and Geoponica, or books on this subject, existed already in the times of Socrates. Xenophon praised agriculture in his *Æconomicus* and in the *Memorabilia*. Among the Romans, Cato the Censor wrote a treatise entitled *De Agricultura*, M. Terentius Varro composed *De Re Rustica*, whilst Virgil glorified agriculture in his *Georgics*. Columella, a contemporary of Seneca, was the author of a work in twelve books (*De Re Rustica*), whilst the Alexandrian writers, too, compiled many treatises dealing with agriculture.

George I (George Louis), King of Great Britain, and Elector of Hanover, was the son of the Elector Ernest Augustus, by Sophia, daughter of Frederick, Elector Palatine, and grand-daughter of James I. He was born 28th May, 1660, and died in 1727. In 1682 he was married to Sophia Dorothea of Zell, whom, in 1694, on account of a suspected intrigue with Count Königsmark, he caused to be imprisoned and kept in confinement for the rest of her life. In 1698 he succeeded his father as Elector. He commanded the imperial army in 1707 during the War of the Spanish Succession; and ascended the throne of Great Britain on the death of Queen Anne in 1714. Amongst the notable events of his reign were the rising of the Scottish Jacobites (1715-6); the Triple and Quadruple Alliances against Spain (1717 and 1718); the failure of the South Sea Company (1720). The private character of George I was bad, but he showed much good sense and prudence in government, especially of his German dominions. By Sophia Dorothea he had a son, George, afterwards George II of England, and a daughter, Sophia, the mother of Frederick the Great.—Cf. W. M. Thackeray, *The Four Georges*.

George II (George Augustus), King of Great Britain, son of George I, was born 30th Oct., 1683, died suddenly on 25th Oct., 1760. He married in 1705 Wilhelmina Carolina of Brandenburg-Anspach. In 1708, then only electoral prince of Hanover, he distinguished himself at Oudenarde under Marlborough. In 1727 he succeeded his father on the English throne, but inherited to the full the predilection of George I for Hanover. His reign is notable for the great events with which it is filled, and for the number of men great in art, letters, war, and diplomacy who then adorned England. The War of the Austrian Succession, in which George II himself took part at Dettingen, the Jacobite rebellion of 1745, the conquest of Canada, and the growth of the British Empire in India are amongst the chief events of his reign. He was a prince of very moderate abilities, and ignorant of science or literature; of obstinate temper and vicious

habits; but honest and open in his disposition.—**BIBLIOGRAPHY:** Lord Hervey, *Memoirs of the Reign of George II*; J. McCarthy, *History of the Four Georges and William IV*.

George III, King of Great Britain, born in 1738, died 29th Jan., 1820. He was the eldest son of Frederick, Prince of Wales, by the Princess Augusta of Saxe-Gotha, and succeeded his grandfather, George II, in 1760. In the following year he married the Princess Charlotte Sophia of Mecklenburg-Strelitz. The sixty years of his reign are filled with great events, amongst which are the Wilkes controversy; the American Revolution, 1775-83, the result of which the king felt acutely; the French Revolution, 1789, and the Napoleonic wars which followed, comprising the long struggle that ended at Waterloo; and the Irish Rebellion, 1798. George III was a man of conscientious principles and of a plain, sound understanding, though his narrow patriotism and his obstinate prejudices were hurtful to British interests. His tastes and amusements were plain and practical, literature and the fine arts receiving but a small share of his attention. His private life was exemplary. In 1810 the king's mind, which had already given way several times, finally broke down, and from that time to his death his biography is a blank. Queen Charlotte bore him fifteen children—nine being sons. See *Britain*.—Cf. W. E. H. Lecky, *History of England*.

George IV, King of Great Britain, son of George III and Queen Charlotte, born in 1762, died in 1830. His dissipated life, his extravagance, his supposed (and actual) marriage with a Catholic, Mrs. Fitzherbert, alienated from him the affection of his father and the esteem of the nation. In 1795 he married the Princess Caroline of Brunswick, from whom he soon separated, and who was afterwards tried for adultery in 1820. (See *Caroline*.) In 1811 George became regent, and, on the death of George III in 1820, king. The most important event of his reign was the passing of the Catholic Emancipation Act, by the Wellington ministry, in 1829. As his only daughter, Princess Charlotte, wife of Leopold of Saxe-Coburg (afterwards King of the Belgians), died childless in 1817, he was succeeded by his brother, William IV. See *Britain*.—**BIBLIOGRAPHY:** L. Melville, *The First Gentleman of Europe*; W. H. Wilkins, *Mrs. Fitzherbert and George IV*.

George V, King of Great Britain and Ireland and of the oversea British dominions, Emperor of India, second son of Edward VII and Queen Alexandra, was born at Marlborough House on 3rd June, 1865. After being educated by a private tutor, he and his elder brother, Prince Albert Victor, became naval cadets, and as midshipmen visited many parts of the world. Prince George

attained the rank of commander in 1891, but his brother's death in 1892, which placed him in direct succession to the crown, led to his practical withdrawal from a naval career. Created Duke of York in 1892, he next year married Princess Victoria Mary, daughter of the Duke of Teck. This union has produced five sons and one daughter, the eldest, Prince Edward, having been born on 23rd June, 1894. On the death of Queen Victoria and accession of Edward VII (22nd Jan., 1901) he became Duke of Cornwall, and later in the year was created Prince of Wales. He and the princess had just returned from a great colonial tour, one object of which was to open the first Parliament of the Australian Commonwealth at Melbourne. On their return they were entertained by the Lord Mayor of London at the Guildhall, when the Prince of Wales delivered a notable speech urging the old country to 'wake up' in order to maintain and strengthen her commercial position. The Prince and Princess of Wales spent the winter months of 1905-6 in India, visiting Calcutta and other cities. On the death of Edward VII, 6th May, 1910, the prince became king as George V, and on 22nd June, 1911, he and his consort, Queen Mary, were crowned in Westminster Abbey. Shortly before the outbreak of the European War, King George summoned a conference of party leaders at Buckingham Palace for the purpose of solving the Irish question. No solution, however, was found. King George, who had become popular as the 'Sailor Prince', increased his popularity by his conduct, efforts, and exertions during the European War.

George I, 'King of the Hellenes', was born at Copenhagen, 24th Dec., 1845, second son of the King of Denmark. In 1863 he was elected king by the Greek National Assembly, and in 1867 he married the Princess Olga, a niece of the Russian Tsar. His conduct as a constitutional monarch was always correct and regular, and he won the popular sympathies by the efforts he made on behalf of the expansion of Greek nationality. He was assassinated at Salonica on 18th March, 1913.

George, Duke of Saxony (*the Bearded*), born in 1471, died in 1539, was the son of Albert the Brave, the founder of the Albertine line of Saxony, and succeeded in 1500 to the hereditary dominions of the Albertine House. Later on he became involved in the turmoils of the Reformation period. He was not at first wholly hostile to reform, but thought that it could be better effected by means of Papal edicts than by the revolt of Luther. Accordingly he became embittered by the uncompromising tone of Luther's later writings, and endeavoured to suppress the Reformation in his dominions by violent measures. These, however, were unsuccessful, and

in 1539, on the accession of his brother Henry, who was a Protestant, the Reformation was introduced into the dominions of the Albertine House of Saxony.

George, Henry, American writer on political economy and social reform, born in 1830, died in 1897. He became a journalist and editor of papers, and in 1879 published *Progress and Poverty*, a work that attained an enormous circulation. In it many of the older views of wealth, wages, and capital are attacked, and the conclusion is finally reached that all taxes should be replaced by a single tax levied on land values, thus practically making and recognizing the land as national property, whilst still leaving it in the occupation of individuals. He lectured in the United Kingdom on several occasions between 1881 and 1889. His other works include: *Our Land and Land Policy*; *Social Problems*; *Property and Land*; and *Protection and Free Trade*, a defence of the latter.

George, Lake, a picturesque lake in New York State, among the Adirondacks, south of Lake Champlain, into which it discharges at Ticonderoga, 36 miles long and 4 miles in greatest width. It is surrounded by wooded hills, and dotted with islands.

George, Order of St. The following are the principal of the numerous orders which have been founded in honour of St. George: (1) A military order instituted in Russia in 1709 by the Empress Catherine II as a reward of military achievements. It consists of four classes, to which a fifth, intended for non-commissioned officers and privates, was added in 1807. (2) An order instituted in Bavaria by the Emperor Charles VII (Charles Albert) in 1729, and reorganized by King Ludwig II in 1871. Since the reorganization the order, which had previously been a mere decoration for the nobility, has devoted itself to such services as the care of the wounded on battlefields, &c. (3) An order instituted by Ernest Augustus of Hanover in 1839. (4) A Sicilian military order, instituted by Joseph Napoleon 24th Feb., 1808, and remodelled by King Ferdinand IV in 1819. (5) The name under which the Order of the Garter was first instituted in England. See *Garter, Order of the*.

George, St., a saint venerated both in the eastern and western Churches, and the patron saint of England. He is also the patron saint of Portugal. He was canonized in A.D. 494 or 496 by Pope Gelasius. His origin is very obscure, one of many legends representing him as a prince of Cappadocia martyred by Diocletian. Gibbon has sought to identify this legendary saint with the notorious and turbulent Arian heretic George of Cappadocia, who was slain in 361 in a rising of the populace, who had been infuriated by his

oppression and his violence against pagans and orthodox. But the most eminent scholars, both Roman Catholic and Protestant, are of opinion that the veneration of St. George has been traced up to so early a period as to make it very improbable that a notorious Arian could have been foisted on the Catholic Church as a saint and martyr. The killing of a dragon that was about to swallow a maiden is a legendary feat attributed to him. The story first appeared in the Middle Ages in the *Legenda Aurea* of Jacobus de Voragine. It is plainly derived from the story of Andromeda and Perseus. St. George was adopted by the Genoese as their patron saint, and in 1222 the Council of Oxford ordered that his day (the 23rd of April) should be observed as a national holiday in England; in 1350 he was made the patron saint of the Order of the Garter by Edward III.—Cf. M. H. Bulley, *St. George for Merrie England*.

George, St., one of the Bermudas. It is about 3 miles long and half a mile broad, is fortified, and contains a port of the same name, which is a British military station.

George-noble, a gold coin of the time of Henry VIII of the value of 6s. 8d. sterling; so called from bearing on the reverse the figure of St. George killing the dragon.

George's Channel, St., the arm of the sea which separates Ireland from Wales south of the Irish Sea. From Holyhead and Dublin on the north to St. David's Head and Carnsore Point it extends about 100 miles, with a breadth varying from 50 to 70 miles.

Georgetown, a port of the United States, in the district of Columbia, on the Potomac, incorporated in 1871 in Washington.

Georgetown, or **Demerara**, the capital of British Guiana, at the mouth of the Demerara. It is neatly built, consisting of broad streets at right angles, with canals in the middle, and lofty wooden houses, often with luxuriant gardens attached. There is a bar at the mouth of the river, and large ships have to discharge and load by means of lighters. Georgetown is the seat of an Anglican bishop, and has a number of churches, schools, and hospitals. The chief exports are sugar, rum, and coffee. Pop. about 53,580, about one-seventh being whites.

Georgia (by the Russians called *Grusia*, and by the natives themselves *Karthli*), formerly a kingdom, annexed by Tsar Alexander I in 1801, and included in the Russian government of Tiflis, and since 1918 a democratic republic. It is situated in Transcaucasia, between the Black and Caspian Seas, and has an area of 32,769 sq. miles, and a pop. of 3,053,345 (1915). The natives are a fine-looking race, the Georgian women, like the Circassians, being celebrated for their beauty. The Georgian language, together

with that of the Mingrelians, Lazes, and other Caucasian peoples, seems, according to the latest researches, to form a perfectly distinct linguistic family. It possesses a not unimportant literature, commencing with the introduction of Christianity into the country. The history of the Georgians first becomes trustworthy about the time of Alexander the Great, to whom they became subject. About 324 B.C. they gained their independence under Pharnavas. They became Christianized towards the end of the fourth century. After yielding for a time to the supremacy of the Arabian caliphs, Georgia regained its independence towards the end of the tenth century, which it retained till 1799, when Heraclius, successor of George XI, formally ceded his dominions to the Russian Emperor Paul. After the Russian Revolution of 1917 and the establishment of the Bolshevik regime, the Georgians, Armenians, and Tartars formed the Transcaucasian Republic with Tiflis as capital. Eventually, however, Georgia separated and proclaimed her independence on 26th May, 1918. The Act of Independence was ratified by the Constitutional Assembly on 12th March, 1919. The republic consists of the following provinces and districts: Zakathali, Tiflis, Kutais, Sukhum, Sochi, Ardahan, and Olti. Batum was still occupied by the Turks in 1921, but it was claimed by Georgia ethnographically. The capital, Tiflis (in Georgian, *Tpilis*), has a pop. of 346,766. In Oct., 1921, the Constituent Assembly was still working out the Constitution. The executive power was entrusted to a Cabinet of ministers, and the President of the Cabinet was temporarily acting as head of the State. The republic was recognized by the Allies on 27th Jan., 1921.—BIBLIOGRAPHY: O. Wardrop, *The Kingdom of Georgia*; E. Kuhne, *La Géorgie libre*; *Georgia and the Georgian Race*.

Georgia, one of the Southern United States, bounded north by Tennessee and North Carolina, east by South Carolina and the Atlantic, south by Florida, and west by Alabama; length, north to south, 320 miles; breadth, 255 miles; area, 59,265 sq. miles. The coast is bordered by a chain of islands, separated from the mainland by narrow lagoons or sounds. On them the famous sea-island cotton is raised. The land is low towards the coast, beginning as a salt marsh, grown over with tall reeds, continuing next as swampy rice plantations and then as 'pine barrens' about 60 or 90 miles inland, gradually rising as a sandy district, interspersed with fertile tracts, till it reaches the lower falls of the Savannah, Ogeechee, Oconee, and other rivers. Here the hilly and finally mountainous region called the Upper Country begins, a fertile and salubrious region extending north and west till it rises into the Appalachian mountain-chain. Of

the rivers the Chattahoochee, which flows under the name of the Appalachicola into the Gulf of Mexico, is navigable for steamers for 300 miles; the Savannah is navigable for steamers part of the year for 250 miles; and the Altamaha and its affluents are navigable for small vessels 300 miles upwards. The climate is mild, but unhealthy in the low country during July, August, and September. The soil in many parts is very rich. Cotton, rice, maize, and the sugar-cane are the staple productions; but tobacco, the sweet potato, and other crops are cultivated with success. The fruits, which include peaches, apples, melons, oranges, bananas, &c., are of the finest. Copper and iron, also gold in considerable quantities, are found in the northern parts. Atlanta is the seat of the legislature and largest town; the other principal towns are Savannah (the chief seaport), Augusta, Macon, and Columbus. A charter for the foundation of a colony in the territory now called Georgia was obtained in 1732 by General Oglethorpe from George II, after whom the state was named. Georgia was one of the thirteen original states. In 1788 it adopted the Constitution of the United States by a unanimous vote. In Jan., 1861, Georgia seceded with the Confederates, took an active part in the Civil War, and was conquered by a Federal army under General Sherman (1864-5) and restored to the Union, since which, however, it has been twice occupied by United States troops on account of disagreements between Congress and the State Legislature regarding the Constitution. Pop. in 1900, 2,216,329; in 1910, 2,609,121, in 1920, 2,895,832.—BIBLIOGRAPHY: C. C. Jones, *History of Georgia to 1783*; U. B. Phillips, *Georgia* (American Commonwealth Series); Brooks, *History of Georgia*.

Georgia, Gulf of, a large gulf of the North Pacific Ocean, between the continent of North America and Vancouver Island; about 120 miles in length from north to south; the breadth varies greatly in its different parts, from 6 to 20 miles. It communicates with the ocean on the north by Queen Charlotte's Sound, and on the south by the Straits of Juan de Fuca.

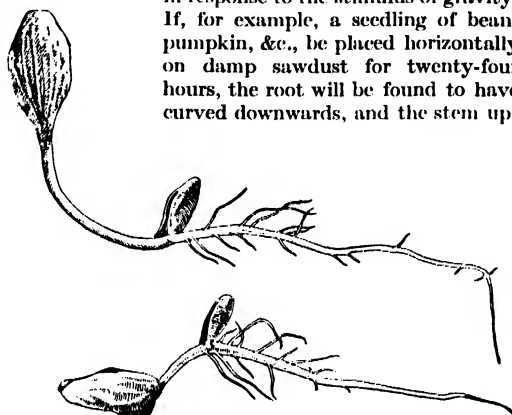
Georgia, South, an island in the South Atlantic, lat. at its north point, 53° 57' s.; long. 38° 13' w. It is 90 miles long, and has high and rocky coasts, inaccessible owing to ice during a great part of the year. It abounds with seals and sea-fowl.

Georgia Bark (*Pinckneya pubens*), a small tree of the Southern United States closely resembling the cinchona or Peruvian bark, and belonging to the nat. ord. Rubiaceæ. It has large white flowers, with longitudinal stripes of rose-colour, disposed in beautiful clusters at the

extremities of the branches; each flower is accompanied by a floral leaf, bordered with rose-colour near the upper margin; the corolla is tubular; the stamens five, with a single style; and the capsule contains two cells and numerous seeds. The wood is soft and unfit for any practical use. The inner bark is extremely bitter, and is employed with success in intermittent fevers.

Georgian Bay, formerly called *Lake Manitoulin*, the north-eastern part of Lake Huron, partly separated from the main body of the lake by the peninsula of Cabot's Head and the Island of Great Manitoulin. It is about 120 miles long and 50 miles broad. The Georgian Bay Canal, planned to connect the Georgian Bay with the St. Lawrence at Montreal, has not yet been constructed. Its cost has been estimated at £30,000,000.

Geotropism, the curvature of a plant-organ in response to the stimulus of gravity. If, for example, a seedling of bean, pumpkin, &c., be placed horizontally for twenty-four hours, the root will be found to have curved downwards, and the stem up-



Geotropism

Pumpkin seedling showing geotropism. Seedling (lower) placed horizontally; in twenty-nine hours the stem has curved upwards and the root downwards (above).

wards, thus returning to their normal vertical position. If, however, the seedling, while in the horizontal position, be slowly rotated around a horizontal axis, so as to equalize the effect of gravity on all sides of the stem and root, these organs, instead of curving, continue to grow in the horizontal plane, thus proving that the unequal growth which brought about the curvature in the first case was due to the one-sided action of gravity. Most primary roots behave like that of the bean, and are said to be *positively geotropic*; stems, on the other hand, are usually *negatively geotropic*. Leaves, as a rule, tend to take up a horizontal position, and are termed *transversely geotropic* or *diageotropic*. The twining of certain stems (e.g. scarlet runner, hop, convolvulus) is due to a

special form of geotropic response called *lateral geotropism*.

Geotrupidæ, a family of burrowing lamellicorn beetles. They inhabit temperate climates, and are useful in removing disgusting substances. When alarmed they feign death. The *Geotrupes stercorarius*, or watchman-beetle of Britain, is the type of the family.

Gera (gā'rá), chief town of the former principality of Reuss-Schleiz, in Germany, on the right bank of the Elster, 35 miles s.s.w. of Leipzig. It has manufactures of woollen, linen, cotton, and other goods. Pop. 73,660.

Gerania'ceæ, a nat. ord. of Dicotyledons, the distinguishing characteristic of which is to have a fruit composed of five capsules or cases, connected with as many flat styles, consolidated round a long conical beak, giving some of the species the name of stork's-bill and crane's-bill. These plants are usually astringent and odoriferous, and many of them have beautiful flowers, especially those of the genus *Pelargonium*, natives of the Cape of Good Hope. The species are mostly herbaceous plants. A few of them have edible tubers.

Geranium, the typical genus of the ord. Geraniaceæ, popular name crane's-bill. They have usually palmately divided leaves and regular flowers, with ten stamens and five carpels. Some thirteen species are wild in Britain, of which the *G. robertianum* or herb-robert is the most common. An American species, *G. maculatum*, from its astringency called 'alum-root', is used medicinally as a gargle and otherwise. The so-called geraniums of our gardens belong to the genus *Pelargonium*. Cultivation has produced many varieties, which from their beauty are great favourites.

Gérard (zhā'rār), François Pascal, Baron, a French historical and portrait painter, born at Rome in 1770, died in 1837. In 1786 he went to Paris, where he studied under David, and in 1795 he exhibited his first notable painting, *Belisarius* (now at Petrograd). He was much patronized by Napoleon, for whom he painted the *Battle of Austerlitz*, and was made a baron by Louis XVIII, after completing his large painting of the *Entrance of Henry IV into Paris* (in the Museum of Versailles). His portraits include: *Napoleon, Talleyrand, Louis XVIII, Murat, and Louis Philippe*.

Gerard, James Watson, American jurist and diplomatist, born at Genesco, New York, in 1867. Educated at Columbia University, he studied law and practised for some time. An associate justice of the Supreme Court from 1908 to 1913, he was appointed by President Wilson United States Ambassador to Germany, and remained in Berlin until 1917, when America entered the European War. During the first

two years of the European War Gerard, as representative of a neutral state, looked after the interests of the British in Germany, and greatly interested himself in the welfare of war prisoners. He published *My Four Years in Germany* (1917), and *Face to Face with Kaiserism* (1918), wherein he severely indicted Germany and her war-aims. He was created a G.C.B. in 1917.

Gérard, Jean Ignace Isidore, a French caricaturist and book illustrator, generally known under the pseudonym of *Grandville*, was born at Nancy in 1803, died at Paris in 1847. He went to Paris in 1824, and after some minor works acquired great popularity in 1828 by his *Métamorphoses du jour*, a representation under the guise of animal heads of human foibles and weaknesses. Later on he became a contributor to *Le Charivari* and an illustrator of the works of Béranger and La Fontaine, and of *Gulliver's Travels* and *Robinson Crusoe*.

Gérard, Maurice Étienne, Count, Marshal, and Peer of France, born 1773, died at Paris in 1852. He served as a soldier during the republic and the empire, distinguishing himself at Austerlitz and other battles. In 1813 he was made a general of division and count, distinguished himself in the battle of Ligny, and at Waterloo acted under Grouchy. He took an active part in the revolution of 1830; became War Minister and Marshal; commanded the troops which reduced Antwerp in 1832; became Prime Minister 1834, and commander of the National Guard in 1838.

Gérard de Nerval, the pseudonym of Gérard Labrunie, French man of letters, born in Paris 1808. His earlier productions were poetic, *Élégies nationales* and *Poésies diverses*. As an adherent of the Romantic school he set himself to translate Goethe's *Faust*, and performed it in a manner which the old poet himself pronounced a marvel of style. Amongst his best works are his short tales and sketches, *Scènes de la vie orientale, Voyage en Orient, Contes et facéties, La Bohème galante*, &c. He became insane, and committed suicide in Paris in 1855.

Gerasa (je-rā'sā), Gerash, or Djerash, a ruined town in Palestine, among the mountains of Gilcad. It was several times destroyed and rebuilt. The ruins, comprising ancient walls, gateways, a forum, baths, theatres, and temples, are very extensive.

Gerba, or Jerba, an island in the Gulf of Cades, off the coast of Tunis. It is about 20 miles long and 14 miles broad. The surface is level and fertile, and occupied by a population of 30,000, mostly Berbers.

Gerbil'us, a genus of small burrowing rodents (the gerbils) of the family Muridæ (mice). They have a long tail, which is tufted at the end. There are numerous species, found in the sandy

parts of Africa and Asia. The Egyptian gerbil (*G. ægyptiacus*), inhabiting Egypt around the pyramids, is the type. It is about the size of a mouse, and of a clear yellow colour.

Gerhardt (ger'härt), Charles Frédéric, French chemist, born 1816, died in 1856. He studied under Liebig at Giessen; went to Paris in 1838, was appointed professor of chemistry at Montpellier, but returned to Paris in 1842 to pursue his investigations. In 1855 he went to Strasbourg as professor of chemistry and pharmacy, but died soon after. Gerhardt is the author of several works, amongst which the most celebrated is his valuable *Traité de chimie organique*. He was the first to introduce the new combining weights, or rather to subject more completely combination by weight to combination by volume; to originate the theory of types; and to furnish new ideas on classification, homology, and similar subjects. The methods he originated have had a great influence on modern chemistry.

Gerhardt, Paul, German hymn-writer, born in 1607, died in 1676. He studied theology, became pastor of Mittenwalde in 1651, and afterwards went to Berlin. A strict Lutheran, he opposed energetically all attempts to unite the Lutheran and Reformed Churches, and was removed from his church in 1666 in consequence of his refusal to subscribe to the edict of 16th Sept., 1664, prohibiting mutual insults or offensive language between the Churches. In 1668 he was made Archdeacon of Lübben, where he died. His excellent book of hymns appeared at Berlin in 1667 (*Geistliche Andachten*). Many particular hymns have found English translators, such as: *Commit thou all thy griefs*; and *Jesus, Thy boundless love to me*.—Cf. Kelly, *Gerhardt's Spiritual Songs*.

Géricault (zhä-rë-kō), Jean Louis Théodore André, a French painter, born at Rouen in 1791, came to Paris in 1806 and studied under Charles Vernet and Guérin. His first pictures (the *Chasseur Officer* and the *Wounded Cuirassier*) were exhibited in 1812 and 1814. In 1817 he visited Italy, returned to Paris in 1819, and painted the *Raft of the Medusa* (a well-known shipwreck of the time), a work of much power, which won great popularity. He took this work with him to England, where he exhibited it at a shilling admission and realized £800. During his stay in England he painted his *Race for the Derby at Epsom*. He died at Paris in 1824.

Germ, in physiology, the earliest form under which any organism appears, that is, the rudimentary or embryonic form. The name is also given to certain minute organisms which give rise to disease. See *Germ Theory of Disease*.

Germain (zher-man), St., the name of a number of places in France, among which is St. Germain-en-Laye, a town in the department of Seine-et-Oise, about 6 miles north of Ver-

sailles and 11 miles w.n.w. of Paris, on the left bank of the Seine. The most remarkable building is the royal palace, commenced by Charles V in 1370, and embellished by several of his successors, especially Francis I and Louis XIV. It was used as a prison during the Revolution, afterwards as a school for cavalry officers, and was ultimately restored in 1862 by Napoleon III, who established in it a museum of Gallo-Roman antiquities. The Treaty with Austria was signed here on 10th Sept., 1919. The forest of St. Germain is one of the finest in France, extending over 10,000 acres. Pop. 17,700.

German, Edward, British composer, was born at Whitechurch, Shropshire, 17th Feb., 1862, and educated at Bridge House School, and the Royal Academy of Music, which he left in 1887. In 1888 he became musical director at the Globe Theatre, and while there produced incidental music to *Richard III*, which first brought him into prominence. His incidental music to *Henry VIII* (1892) and to *Nell Gwyn* (1900) is well known. He completed *The Emerald Isle*, an opera left unfinished by Sullivan (produced in 1901), and also composed the scores of the light operas *Merrie England* (1902), *A Princess of Kensington* (1903), and *Tom Jones* (1907). In 1909 he wrote the music for *Fallen Fairies*, Gilbert's operatic version of his early play *The Wicked World*. He has also composed many orchestral symphonies and songs. His music is widely popular, and is distinguished by tunefulness and a certain quaint old-world air.

German Catholics, a religious sect which sprang up in Germany about the close of the year 1844. The immediate cause of its formation was the exhibition by Arnoldi, Bishop of Trèves, of the holy coat preserved in the cathedral of that city, accompanied by a promise of plenary indulgence to whoever should make a pilgrimage to Trèves to worship it. The announcement caused a general feeling of astonishment in Germany, and two priests, Johannes Ronge of Silesia and Johann Czerski of Posen, whose independent views had already caused the deposition of the one and the secession of the other, led a secession movement, appealing to the lower grades of clergy to unite in founding a National German Church independent of the Pope. Many congregations were formed, especially in Leipzig, under the celebrated Robert Blum, and in Magdeburg under the teacher Kote. Two creeds were drawn up for the new Church, the *Confession of Schneidemühl*, by Czerski, which, though substantially Roman Catholic, rejected indulgences, purgatory, and auricular confession, and the *Confession of Breslau*, drawn up by Ronge. The latter, which was much less orthodox, was substantially adopted by the Council which met at Leipzig on 22nd March, 1845. The organiza-

tion was almost the same as that of the Presbyterian Dissenting Churches of Scotland. Each congregation was to choose its own pastor and elders. For a time the new Church had a great success. Many Protestants joined the body, which by the end of 1845 numbered nearly 800 congregations. Difficulties soon arose, however. The majority of the German Governments began to use repressive measures. More fatal were internal dissensions, one party, headed by Czerski, clinging to the traditions and doctrines of the Roman Catholic Church, the other, headed by Ronge, tending to mix up democratic and socialistic principles with their creed. The result, in spite of several attempts to re-establish unity, was disintegration and decay. The congregations rapidly dwindled, many being readmitted to the State Church, and, especially after the rise of 'Old Catholicism', the movement lost all importance.

German'der, the common name of three British plants of the genus *Teucrium*, ord. Labiatae, namely *T. Chamædrys*, wall-germander, *T. scordium*, water-germander, and *T. scorodonia*, wood-germander or wood-sage. They were all formerly used in medicine, and are still employed by country herbalists.

German East Africa. See *Tanganyika Territory*.

German'icus, Cæsar, a distinguished Roman, son of Nero Claudius Drusus and the younger Antonia, a niece of Augustus, was born 15 B.C. He was adopted by Tiberius, his paternal uncle, and married Agrippina, the granddaughter of Augustus. When Augustus died, in A.D. 14, Germanicus was invited by the rebellious legions on the Rhine to assume the sovereignty, but refused, and quelled the revolt. He then crossed the Rhine, and surprised and defeated the Marsi with great slaughter. Next year (A.D. 15) a campaign against the Catti and the Germans, led by Arminius, resulted in a series of victories. The following year he again made his way into Germany, defeated the Cherusci twice, and made an incursion into the country of the Marsi. Tiberius now became jealous of the glory of Germanicus, called him home under pretence of granting him a triumph, then, to get rid of him, sent him into the East to compose the disturbances in Armenia and Cappadocia. This he performed in A.D. 18, visited Egypt the following year, and died on his return to Syria (A.D. 19) under some suspicion of having been poisoned by Cn. Piso, the Governor of Syria.

German Silver, **Nickel Silver**, or **Pack-fong**, is an alloy of copper, nickel, and zinc, containing 40 to 65 per cent copper, 15 to 30 of zinc, and 6 to 35 of nickel. The alloys containing most nickel are the most expensive, but they have the best colour and mechanical properties.

Small quantities of lead are often added to assist the working of the metal. Alloys containing 80 per cent of zinc, 6 to 12 nickel, the remainder being copper, are used for small mechanical parts. For castings, high-pressure steam-fittings, &c., 70 per cent copper, 10 zinc, 20 nickel is used; for tableware the alloy contains 55 to 60 per cent copper, 20 to 25 zinc, and 20 nickel. German silver has been used for coinage in Belgium and Chile.

German Tinder, or **Amadou**, is prepared from the *Bolëtus fomentarius*, a fungus growing on the oak, birch, and some other trees, or from the *Bolëtus ignarius*, found on the willow, cherry, plum, and other trees. The fungus is removed with a sharp knife, washed, boiled in a strong solution of salt-petre, beaten with a mallet, and dried. In surgery it is sometimes used to stop local bleeding.

Germantown, a northern suburb of Philadelphia, pleasantly situated on high ground, and containing numerous fine houses. Here the British under General Howe defeated the Americans under Washington, 4th Oct., 1777.

Germany (Lat. *Germania*; Ger. *Deutschland*; Fr. *Allemagne*), the name given collectively to the states in Central Europe which, until Nov., 1918, constituted the German Empire. Since 1918 Germany is a federation of eighteen republican states. The Commonwealth is bounded north by the North Sea, Denmark, and the Baltic Sea; east by Lithuania and Poland; south by Czecho-Slovakia, Austria, and Switzerland; and west by France, Luxembourg, Belgium, and Holland. As one of the Teutonic peoples the Germans are akin by race to the Dutch, English, and Scandinavian peoples. The capital of Germany is Berlin; other large towns are Hamburg, Breslau, Munich, Dresden, Leipzig, Cologne. In 1914 the total area of the German Empire was 208,780 sq. miles, and the pop. 67,812,000. As a result of the European War Germany had to cede Alsace-Lorraine to France, West Prussia and part of East Prussia to Poland, Eupen and Malmedy to Belgium, Memel and Danzig to the Allies, and a portion of Upper Silesia to Czecho-Slovakia. Provision was also made by the Treaty of Versailles to settle the fate of the Saar Basin, of Schleswig-Holstein, and of Upper Silesia by *plebiscites*. In 1920 the northern zone of Schleswig voted for Denmark, the southern for Germany, whilst the result of the plebiscite in Upper Silesia, in March, 1921, was in favour of Germany. In view, however, of the opposition of France and Poland, the question of Silesia was referred to the Council of the League of Nations. (See *Silesia*.) Germany thus lost by the Treaty of Versailles over 24,000 sq. miles of her territory, and her population was reduced by over 5,000,000. The present area of Germany is therefore about 183,381 sq. miles, and her pop. (1919), 60,900,197.

Physical Features.—Germany, as regards its surface, may be divided into three different regions. Farthest south is the Alpine region along the southern frontier, comprising parts of Bavaria, Württemberg, and Baden, lying next to Austria and Switzerland. North of this the Suabian-Bavarian plateau extends to the mountain region of Central Germany, where the chain known as the Fichtelgebirge is continued east by the Erzgebirge and the Riesengebirge, forming the boundary next Austria; west by the

(occupied by France), and in Lower and Upper Silesia (the latter in the plebiscite area). Other minerals are tin, silver, quicksilver, antimony, sulphur, marble, kaolin, asbestos, and freestone. It is rich in mineral waters. Though the country extends over $71\frac{1}{2}^{\circ}$ of latitude, its mean annual temperature is remarkably uniform. This is owing mainly to the different elevations of the surface, the low plains of the north having a higher, while the hills and plateaus of the south have a lower temperature than their



The German Empire before the European War

Thüringerwald, Rhöngebirge, and Spessart; farther north lie the Harz Mountains. The great plain in the north extends without interruption to the North Sea and the Baltic. Germany is remarkably well watered. Its central mountain region and plateau form part of the great water-shed of Europe. The Danube proceeds across it in an easterly direction, and the Rhine, though it neither rises nor terminates within Germany, flows within it for the greater part of its course. After these come the Elbe, Oder, Vistula, Weser, Main, Neckar, Mosel, Ems, and Fider—all of them navigable. Germany possesses much varied mineral riches, the most important minerals being coal and lignite, iron, zinc, lead, copper, and salt. Rich coal-mines are found in the Ruhr Valley, in the Saar Basin

latitudes might seem to indicate. The mildest climate is enjoyed by the valleys of the Rhine and the Main.

Agricultural Products, &c.—These are varied and numerous. With exception of the loftier mountain districts, where the surface is fit only for pasture, the growth of all the ordinary cereals is universal. Potatoes, hemp, and flax also form most important crops, and in many parts sugar-beet, tobacco, and hops are cultivated on an extensive scale. Wine is produced in many districts. The cultivation of the vine diminishes in importance from south-west to north-east, but is carried on to some extent even in the Prussian provinces of Saxony and Brandenburg. The forests are of great extent and value, particularly in the mountain districts.

The central plateau is more sparingly wooded, but the eastern part of the north plain has extensive forests. Among domestic animals, the horned cattle of the districts along the North Sea and the Baltic, the sheep of Saxony and Silesia, and the swine of Westphalia have long been famous. The horse, except in East Prussia, Mecklenburg, and some other parts, appears to be much neglected. Game is very abundant, and includes, in addition to the smaller kinds, the stag, boar, and wolf. Fish are numerous, both in the rivers and lakes.

Manufactures.—Linen is made in every part of Germany, but more especially in Westphalia, Silesia, and Saxony; woollen goods in the Prussian provinces of the Rhine, Saxony, Brandenburg, and Silesia; they are also made in Bavaria. Cotton goods are produced in Württemberg, Baden, and Bavaria; the silk manufacture flourishes in the Rhine provinces and in Baden; iron and other metal manufactures are carried on in most of the states, but principally in Prussia, Bavaria, and Saxony; steel is largely manufactured in the Rhine provinces. The manufactures of beet-sugar, leather, dyes, chemicals, paper, porcelain, glass, hats, musical instruments, watches, clocks, wooden wares, including toys, are likewise important; and breweries and distilleries are to be met with everywhere.

Commerce.—Before the outbreak of the European War the German commerce was very extensive, and was carried on under the regulations of the Zollverein or Customs Union, which embraced the whole of Germany and also Luxembourg. The exports and imports comprised a great variety of manufactured goods and raw products. The manufactures of Germany were sent to all parts of the world, and in various places there was a strong competition between German and British goods. The staple exports to Britain were sugar, textiles, machinery and metal goods, glass, timber, and eggs. Britain sent to Germany cottons and woollens, machinery and metals, herrings, coal, and wool. In 1913 the total imports of Germany were £560,335,800, and the exports, £509,965,000. The German merchant navy contained in 1914, 4935 ships of 3,320,071 tons burden, of which 2170 were steamers having a tonnage of 2,832,312. By far the principal seaport is Hamburg; others are Bremen and Bremerhaven, Stettin, Königsberg, and Lübeck. The total length of railways in 1918 was about 38,809 English miles. By the law of 4th Dec., 1871, a uniform gold standard was introduced for the monetary system of the whole country. The denominational unit is the *mark*, of the normal value of 11½*d.* of British money, and divided into a hundred *pfennige*. Since 1872 the French metrical system of weights and measures has been in force in

all the states of Germany. See *Metric System*.

Finances.—The revenue is derived principally from the customs duties collected throughout the Zollverein, from excise duties on beet-root sugar, salt, tobacco, and malt, and from the contributions made by each state in proportion to its population. According to the Budget for year ending 31st March, 1921, the total revenue (ordinary and extraordinary) would amount to £4,530,615,317; the estimated total expenditure was to £2,875,083,507. The total revenue for 1919 was £2,402,938,380, and the expenditure was the same (the pound sterling is calculated at 20 marks gold).

Constitution.—Until 9th Nov., 1918, when the abdication of the emperor was announced, the Constitution of the German Empire was based upon the decree of the 16th April, 1871, which took effect on the 4th of May following. The presidency of the empire belonged to the Crown of Prussia, to which was attached the title of German Emperor (*Deutscher Kaiser*). The prerogatives of the emperor were to represent the empire in its relation to other states, to declare war, if defensive, and conclude peace in name of the empire, to contract alliances, &c. The emperor had also the supreme command of the army and the navy. His power was practically unlimited. He appointed the Imperial Chancellor, who was responsible to him alone. The legislative authority was vested in the Bundesrath (Federal Council) and the Reichstag (Imperial Diet), the former consisting of 58 representatives of the different states of the empire, namely, 17 from Prussia, 6 from Bavaria, 4 each from Saxony and Württemberg, 3 each from Baden and Hesse, 1 each from Saxe-Weimar, and others. The Reichstag consisted of 397 Deputies, elected by ballot and universal suffrage in all the states of the empire. On the average one member was returned to the Reichstag for every 124,500 of the inhabitants.

After the abdication of the Kaiser, 9th Nov., 1918, the German Empire became a republic, and the Council of People's Commissioners took over the government. In Jan., 1919, elections were held for a National Assembly, which met at Weimar on 6th Feb., 1919. The first President of the Republic was elected on the 11th Feb., 1919, and the Constitution was adopted in July of the same year. In accordance with the new Republican Constitution, the power of the state is derived from the people. Suffrage is universal, equal, direct, and secret. The members of the legislative Reichstag are elected for four years, and the President of the Republic is elected by the whole German people for a period of seven years. Besides the Reichstag (or Parliament) there is also a Reichsrat (or Imperial

Council), composed of representatives of all federated (republican) German states.

Army and Navy.—Before 1914 service in the German army or navy was obligatory on every man in Germany who was not morally or physically unfit, and no substitution was allowed. Liability to serve began from the completion of the seventeenth year, but as a rule the six years' service required in the standing army (seven in the cavalry and field artillery) was from the twentieth to the twenty-seventh year. Two of the six years (or three as the case might be) were spent on the active list, and the remaining four in the reserve. After quitting the army of reserve, the next five years were passed in the first class of the Landwehr, and seven in the second. All able-bodied men from seventeen to forty-five who were not in the line, the reserve, or the Landwehr, belonged to the Landsturm, which was called out only in case of invasion of the territory of the empire. The peace strength of the German army before 1914 was about 584,000 men. During the European War Germany put in the field about 10,000,000 men; her strength decreased considerably, but the total strength of her army on 11th Nov., 1918, was still about 6,000,000 men. By the Treaty of Versailles the German army is reduced to 100,000 men. During 1919, however, various military organizations came into existence, under the pretext that they were required to maintain order. In 1920 these military associations were disbanded, except in East Prussia and Bavaria. Under the Treaty of Versailles the German navy ceased to exist. The German Government was allowed to maintain a navy recruited only on the voluntary system. The fleet may consist only of six battleships, six light cruisers, twelve destroyers, and twelve torpedo-boats. The scuttling of the German ships interned at Scapa (21st June, 1919) put an end to the German High Seas Fleet.

Religion and Education.—The new Constitution of the German Republic provides for complete social and religious equality and for entire liberty of conscience. At the census of 1910 Germany contained 34,991,421 Protestants, 23,821,453 Catholics, 283,894 Christians of other denominations, and 615,021 Jews. Education is compulsory throughout Germany. Every commune or parish must support at its own cost a primary school. Every town in addition must maintain one or more middle schools, which supply a higher education than the elementary schools. Above these are *real schools* (*Realschulen*) giving a still higher education, nearly corresponding to what is called the *modern side* in Great Britain; institutions of similar standing called *gymnasiums*, giving an education in which the ancient languages form a more important

element; and, above all, the universities, of which there are twenty-three in the country, the chief being those of Berlin, Leipzig, and Munich. There are also numerous libraries, academies, and learned societies. The Germans as a whole are perhaps the most systematically educated people in the world, although until the Revolution of 1918 the tendency of education was to lay stress on obedience to the State rather than on the development of a spirit of self-reliance.

History.—The date of the first arrival of the Germanic or Teutonic races in Europe is unknown. At the close of the second century B.C. Germanic tribes called Cimbri and Teutones left their homes in the Danish peninsula, and descending upon Italy were defeated by Marius at Aquæ Sextiæ (Aix in Provence) and Vercellæ in Northern Italy. The Romans did not come again in contact with the Germans till Cæsar's invasion of Gaul brought on a contest with the Suevian prince Ariovistus (58 B.C.). At that time several German tribes had crossed the Rhine and settled in the district between that river and the Vosges Mountains, while others had pushed their way through what is now Belgium. The Germans on the left bank of the Rhine were soon subjugated, and two expeditions were made by Cæsar across the Rhine. Under Augustus a systematic attempt was made to subjugate the vast and little-known region Germania, extending between the Rhine and the Vistula, and from the Danube to the North Sea. Tiberius reduced all the tribes between the Rhine and the Elbe, but a few years later there was a revolt, in which three Roman legions under Varus were annihilated by Arminius, leader of the Cherusci, about A.D. 9. The attempt to subjugate the Germans was given up by Augustus; and Germanicus, although he avenged the defeat of Varus by a succession of campaigns, failed to recover the Roman ascendancy. About this time each tribe or nation among the Germans is described as having been divided into four classes: (1) The nobles, from whom the kings and chiefs of the districts were chosen. (2) The freemen, who, with the nobles, had the right to choose their residence and hold heritable property, and who formed the chief strength of the armies and voted in the popular assemblies. (3) The freedmen, a middle class between freemen and slaves, had no landed property, but farmed the land; they were not admitted to the popular assemblies. (4) The slaves, who were entirely in the power of their masters. In religion the Germans were polytheists. Among their great gods were Woden (or Odin), Donar (Thor), Thiu (Tyr), and Frigga. They erected no temples and had no idols, but believed in a future life and in eternal justice.

As the aggressive force of the Roman Empire

abated, it continued to be more and more subject to the incursions of the Germans, who by the end of the fifth century had overrun Gaul, Italy, Spain, and part of Africa. After this Germany itself continued in a divided state till it came under the single rule of Charlemagne. (See *France*.) The history of the German Empire properly commences with the Treaty of Verdun (A.D. 843), which separated the land of the Eastern Franks under Ludwig the German from that of the Western and Central Franks. Out of Ludwig's kingdom was developed the German nationality. Charles the Fat became emperor in 881, and three years later was also elected King of the West Franks, thus again uniting under one sceptre the monarchy of Charlemagne. After his deposition in 887 the two territories of the Eastern and Western Franks were again separated, the former electing Arnulf as their king. He died in 899, and was succeeded by his infant son Louis, who was proclaimed King of Lorraine in 900, assumed the title of emperor in 908, and as such is designated Louis IV. He died in 911, and the German nations chose Conrad, Count or Duke of Franconia, as his successor. He died in Dec., 918, of a wound received in battle with the Huns. In 919 Henry the Fowler, Duke of Saxony, was elected. He was succeeded by his son Otto the Great in 936, who revived the empire of Charlemagne, receiving the crown of the Holy Roman Empire from the Pope in 962. He died in 973, and was succeeded by his son Otto II, who had been crowned emperor by the Pope in his father's lifetime. Henry II, Duke of Bavaria, surnamed the Saint, the hereditary heir of the Saxon line, was elected at Mainz, on the death of Otto in 1002, crowned emperor in Rome 1014, and died in 1024. With him ends the Saxon line of emperors.

Conrad II, surnamed the Salic, a Franconian nobleman, was chosen to succeed him. He spent several years in Italian wars, defeated the Poles, and restored Lusatia to the empire. He died in 1039. He was succeeded by his son Henry III, who had been chosen in his lifetime, and who, the imperial power being now at its highest point, exercised more despotic authority in Germany than any of his predecessors. The fruits of his policy were lost by his son Henry IV (1056-1106), who was passionate and weak. In his reign occurred the famous quarrel with the Pope regarding investitures, which ended in Henry having to humble himself before the Pope at Canossa. His life was embittered by contests against rival emperors, and subsequently by the defection of his own son Henry to the Papal party, by whom he was eventually deposed. Henry V (1106-25) inherited, however, the quarrel of the investitures, took Pope Paschal II prisoner, and was excommunicated by seven

councils. At length the question of investiture was settled by the Concordat of Worms (1122). On his death there was a contested election and a civil war between Lothaire, Duke of Saxony, and Conrad of Hohenstaufen, in which the former was successful.

A contest was now begun between the Saxon and Hohenstaufen (Suabian) families, in which the celebrated party names Guelph and Ghibelline originated. On the death of Lothaire in 1138 Conrad III (of Hohenstaufen) was chosen to succeed him. Conrad died in 1152, and was succeeded by his nephew Frederick Barbarossa (q.v.). His son Henry VI began his reign with a war in Southern Italy. He conquered Sicily, and was crowned king of it in 1194. He died at Messina in 1197. Philip, brother of Henry, and Otto IV were elected by rival factions in 1198. Philip, who was successful, was assassinated in 1208. Otto IV, the son of Henry the Lion, was recognized by the Diet of Frankfurt in 1208 as the successor of Philip. He attempted the conquest of the Two Sicilies without success, and died in 1218. Frederick II, King of the Sicilies, was elected emperor in 1212. His life passed in contentions with the Popes and the Lombard cities. He died in 1250. Conrad IV, his son, had to contend against William of Holland. He died in 1254. He was the last emperor of the House of Hohenstaufen, which became extinct on the death of his son. His successor, William of Holland, was slain in Friesland in 1256. Richard, Earl of Cornwall, and Alfonso X, King of Castile, were chosen emperors in 1257; but the internal divisions of Germany had already deprived the office of all authority, and neither of them had any power. Until 1273 the German Empire had no real head.

Rudolph, Count of Habsburg and Cyburg, the most powerful prince in Helvetia, was chosen emperor (1272). He enriched his own family by his victories over the King of Bohemia, and acquired Austria, Styria, and Carinthia as imperial fiefs for his sons Albert and Rudolph. He died in 1291. Adolphus of Nassau, his successor, was deposed in 1298 by the Diet of Mainz. Albert I, son of Rudolph, was chosen emperor the same year. He is chiefly celebrated for his wars with the Swiss as Duke of Austria, which led to the independence of Switzerland. He died in 1308, and was succeeded by Henry VII of Luxembourg, nearly the whole of whose reign was passed in Italy, where he died in 1313. In 1314 a double election took place: Frederick, Duke of Austria, sometimes called Frederick III, was elected along with Louis of Bavaria. On the death of Frederick in 1330 the latter became sole emperor. He died excommunicated and deposed in 1347. Charles IV, King of Bohemia, was elected in 1346. His reign is chiefly distin-

guished for the Golden Bull (1356) regulating the electorate. (See *Golden Bull*.) He died in 1378. Wenceslaus, his son, was deposed for his excesses in 1400. Rupert, Count Palatine, elected 1400, possessed little authority. Sigismund, King of Hungary and Bohemia, son of Charles IV, was elected by a party in 1410. His reign is distinguished by the commencement of the Reformation in Bohemia, by the Council of Constance, and the condemnation of Huss and Jerome. He died in 1437. Albert II (V of Austria) was elected in 1438, and died in 1439. He was succeeded by Frederick III, Duke of Styria and Carinthia. He was the last emperor who was crowned in Rome. Henceforth the German emperors were always of the House of Austria. He died in 1493. His son Maximilian I succeeded. During his reign the Diet of Cologne was held, which divided the estates of the empire into ten circles for the better maintenance of the public peace.

Since its rise the empire had undergone many changes. At the extinction of the Carolingian dynasty Germany was divided into five nations or dukedoms — Franconia, Suabia, Bavaria, Saxony, and Lorraine. Henry the Fowler and the Ottos added the marches of Austria and Misnia; Henry the Lion and Albert of Brandenburg, Mecklenburg and Pomerania. The House of Austria added Styria, Carinthia, Carniola, and the Tyrol. But Switzerland had been lost, and the old Burgundian territories of the empire, Franche Comté, the Lyonnais, and Provence, had gone to consolidate the French monarchy under Louis XI. Bohemia and Hungary, and many of the Italian cities, especially in the north, were also connected with the empire, but the connection was more formal than real, and the circles established by the Diet of Cologne (1512) represented at that time the estates of the empire, viz.: (1) Austria; (2) Bavaria; (3) Swabia; (4) Franconia; (5) the Upper Rhine (Lorraine, Hesse, &c.); (6) the Lower Rhine, or the Electorates (Mainz, Trier, Cologne); (7) Burgundy (Netherlands); (8) Westphalia; (9) Lower Saxony (Brunswick, Lüneburg, Lauenburg, Holstein); (10) Upper Saxony (Saxony, Brandenburg, Pomerania).

The chief political machinery of the empire was connected with the Diet. The exact constitution of the early German Diets is not known. In the twelfth century the counts of the empire became distinguished from the princes, and lost the right of voting in the Diets. The election of an emperor was at first undertaken by the whole Diet. In the thirteenth century the number of Electors was restricted to seven, to which two more were afterwards added. (See *Electors*.) The Diets were called by the emperor at his own pleasure, but as they had the power of

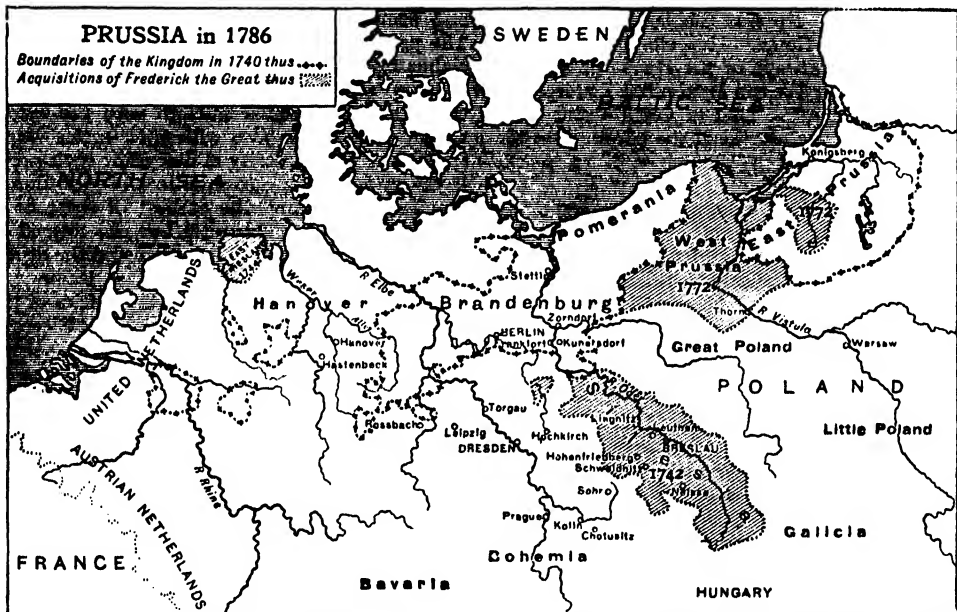
granting supplies their meetings were frequent; and as their authority over the different states was partial, and their policy could only be carried out by the executive force of the emperor, they can hardly be regarded as an independent power in the state. Neither the time nor the place of meeting of the Diets was at first fixed. From an early period the cities of Germany were represented in the Diet. In early times they generally supported the authority of the emperor, as their interest was common with his in diminishing the power of the greater vassals. Municipalities were at first established about the reign of Frederick I, and soon began to assert their independence. The predatory habits of the nobles, besides the claims of superiority over entire cities or particular citizens asserted by the princes, involved the cities in continual warfare with the feudal nobility, and often also with their ecclesiastical superiors. The necessity of defending their privileges compelled them to enter into leagues among themselves. Among the earliest of these combinations was the Hanseatic League, formed to resist both the oppression of rulers and the depredations of land and sea robbers. A league was formed in 1255 by more than sixty cities of the Rhine, headed by the three ecclesiastical Electors, to resist the depredations of the lesser nobles. The Suabian League, formed in 1276, was of similar origin. These leagues were met by counter-associations of nobles and princes.

Maximilian, who succeeded to the empire in 1493, was succeeded in 1519 by his grandson Charles V. (See *Maximilian I*; *Charles V*.) The reign of Charles, the most important in the German annals and the most brilliant in the sixteenth century, was divided among three great conflicts—the continued struggle between France and Germany, the conflict with the encroaching Ottoman Empire, and that with the Reformation. In 1556 Charles resigned the empire to his brother Ferdinand. The Council of Trent was concluded in Ferdinand's reign. He died in 1604. Then followed Maximilian II, Rudolph II, Matthias, and Ferdinand II. By this time was begun a religious war, by which Germany was devastated for thirty years, hence called the Thirty Years' War.

The invasion of Germany by Christian IV of Denmark in 1625, the Peace of Lübeck (1629), the invasion of Gustavus Adolphus (1630), the battles of Leipzig in 1631, of the Lech and Lutzen in 1632, of Nördlingen in 1634, the war with France in 1635, belong to the history of the Thirty Years' War (q.v.). Ferdinand died in 1637, and was succeeded by his son Ferdinand III. Ferdinand III had gained a military reputation at the battle of Nördlingen, but Banér, Bernhard of Saxe-Weimar, Torstenson, Turenne, and the Great Condé gained repeated victories

over his troops. He was at length induced to enter into negotiations; and the Thirty Years' War was concluded by the Peace of Westphalia (24th Oct., 1648), in which the policy of France and Sweden was triumphant. The principal conditions which concerned Germany were a general amnesty and restoration of rights. France received definitively the bishoprics of Metz, Toul, and Verdun, with Breisach, Upper and Lower Alsace, and ten imperial cities in Alsace. Sweden received Rügen, and Hither Pomerania and part of Farther Pomerania, with some other territories.

Marlborough and Eugene (Blenheim, Oudenarde, Malplaquet). The Emperor Leopold died in 1705. He was succeeded by his son Joseph I, who died in 1711. Joseph was succeeded by his brother Charles VI (q.v.). The alliance against France was dissolved by the Peace of Utrecht in 1713, to which the emperor refused to accede, and was left alone against France. After a brief campaign between Prince Eugene and Villars he acceded to the Treaty of Rastadt, negotiated between these commanders, 7th March, 1714. The Spanish Netherlands, and Naples, Milan, Sar-



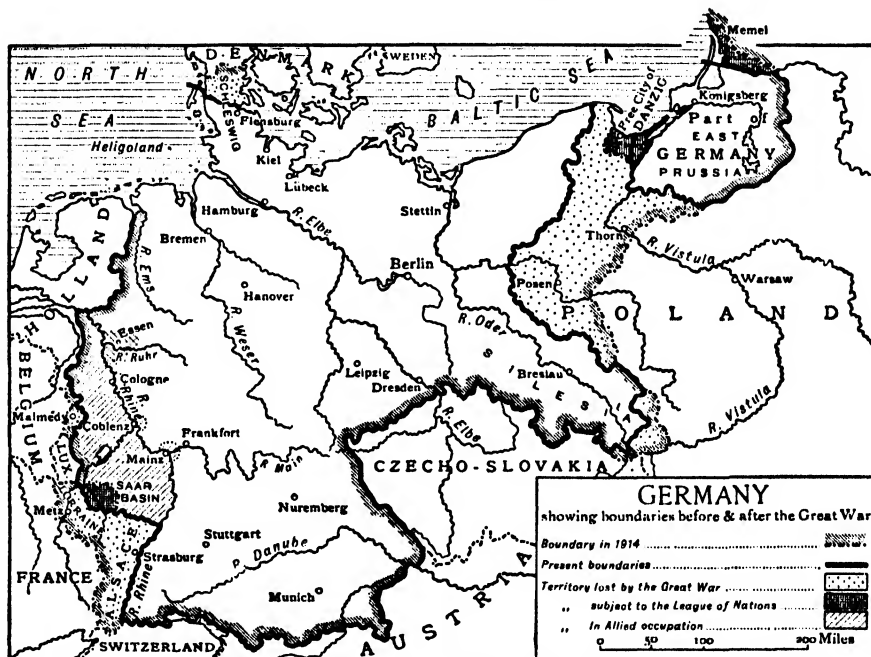
Greater power was given to the Protestants; and the right of the princes and states to make war and alliances among themselves or with foreigners was recognized.

The emperor died in 1657. His son Leopold I was elected emperor in 1658. The success of Louis XIV in his invasion of Holland led to a coalition against him, in which the emperor joined (1673). The war was continued for some years, and terminated by the Peace of Nimeguen, 1679. The League of Augsburg, in which the emperor joined, led to a protracted war with France, which was concluded by the Peace of Ryswick. In 1692 the emperor erected Hanover into an electorate, and in 1700 he permitted the Elector of Brandenburg, Frederick III, to take the title of King of Prussia. The War of the Spanish Succession, in which Great Britain, Holland, and the empire were leagued against France, was begun in 1702. To it belong the victories of

din, and other Italian conquests were left to the emperor. Having no male heirs, Charles had promulgated in 1713 the Pragmatic Sanction, regulating the succession to his hereditary dominions in favour of his daughters in preference to those of his brother Joseph I. He died in 1740. Charles Albert, Elector of Bavaria, son-in-law of Leopold I, got himself chosen emperor (as Charles VII) in 1742. He laid claim to the hereditary possessions of the House of Austria, and entered into an alliance with France, Spain, Prussia, &c., against Maria Theresa, daughter of Charles VI. But he died in 1745, and Francis I, Grand-Duke of Tuscany, the husband of Maria Theresa, was elected emperor; thus the House of Habsburg-Lorraine, which had succeeded to the hereditary possessions of Austria, was recognized as the head of the empire. After a brief interval took place the Seven Years' War (1756-68), in which Austria, Russia, France, and

Saxony combined against Prussia, then ruled by Frederick the Great. The Peace of Hubertsburg (15th Feb., 1763) concluded the war, Prussia retaining her acquisitions. In 1765 Joseph II succeeded to the imperial crown, becoming at the same time co-regent with his mother of the Austrian hereditary dominions. He joined with Russia and Prussia in the first partition of Poland (1772). He was succeeded by his brother Leopold, who, having died in 1792, was succeeded by his son Francis II. He joined in 1793 in the second partition of Poland. He took the

states, exclusive of Austria. Revolutionary outbreaks caused great disturbances in various German states in 1830 and 1848, particularly the latter. The German Diet was restored in 1851 by the efforts of Prussia and Austria, who were rivals for the supremacy in the Confederation. In 1866 the majority of the Diet supported Austria in her dispute with Prussia respecting the disposal of the duchies of Schleswig and Holstein, whereupon Prussia withdrew from the Confederation and declared it dissolved. The Seven Weeks' War between Austria and Prussia



command of his army against the French in 1794, concluded the Peace of Campo Formio with Bonaparte (17th Oct., 1797); joined the second coalition against France in 1799, and concluded the Treaty of Lunéville (3rd Feb., 1801); joined the third coalition in 1805, and concluded the Treaty of Presburg (26th Dec., 1805). In 1804 Francis took the title of hereditary Emperor of Austria, renouncing two years later that of head of the German Empire, which, indeed, had ceased to exist, owing to the conquests of Napoleon.

The states of Germany were again united, by the Treaty of Vienna (1815), in a confederation called the German Confederation (*der Deutsche Bund*). In 1818 a general commercial league, called the Zollverein, was projected by Prussia, and was gradually joined by most of the German

ended in the defeat of the former, the loss of her Italian possessions, and her exclusion from the German Confederation, which was re-formed by Prussia under the title of the North German Confederation. After the Franco-German War (q.v.), in which the South German States, as well as the North German Confederation, supported Prussia, the King of Prussia was proclaimed German Emperor (William I) at Versailles on 18th Jan., 1871. The Parliament of the new empire soon met at Berlin, and adopted the new Constitution. William I was succeeded by his son Frederick, who reigned only ninety-nine days, and was succeeded by his son, William II, in 1888. (See *Prussia*.) The war gave Alsace-Lorraine to Germany, which afterwards acquired large areas in S.W. and E. Africa, with a portion of New Guinea, and the chief Samoan islands.

During the reign of Kaiser William II the progress of Germany was very great. Her industries and trade developed considerably, and the military organization of the new empire was the most efficient in Europe. William II's ambition, however, was to make Germany a great naval power, and in this he succeeded, as the navy he had created was second only to that of Great Britain. But his ambition to found a world-empire, to bring about the downfall of the British Empire, and to establish German sway everywhere proved his misfortune. In a European conflagration he saw an opportunity to realize his ambitions, and he was heartily supported by the entire German people. (See *European War*.) Germany fought well but lost, and in 1918 revolutions broke out all over the country, resulting in the abdication of the Kaiser and of all the other German rulers. The empire, which had lasted for nearly half a century, disappeared, and Germany became a Federation of Republics. Ebert was elected first President of the new German Federated Republic, and Scheidemann became Chancellor. In March, 1920, a *coup d'état*, manœuvred by Dr. Kapp, momentarily succeeded, and the President was compelled to flee from Berlin to Stuttgart. Kapp became Chancellor, but his power lasted only a few days. The Ebert Government returned to Berlin, and was able to suppress the Communist and Spartacist risings.—BIBLIOGRAPHY: E. F. Henderson, *A Short History of Germany*; W. A. Holland, *Germany to the Present Day: a Short History*; Viscount Bryce, *The Holy Roman Empire*; B. E. Howard, *The German Empire*; J. W. Headlam, *The Foundations of the German Empire*; Price Collier, *Germany and the Germans*; J. E. Barker, *Modern Germany*; H. Lichtenberger, *Germany and its Evolution in Modern Times*; Prince von Bülow, *Imperial Germany*; F. Runkel, *Die Deutsche Revolution*.

German Language.—German is one of the Teutonic family of languages, of the Aryan or Indo-European stock, and hence is a sister tongue to Gothic, Old English and English, Dutch, Danish, Swedish, and Icelandic. Of these the Gothic, now long extinct, presents us with the earliest specimens of any Teutonic speech that we possess in the fragments of a translation of the Bible made by Bishop Ulfilas about A.D. 380. Old English comes next; German follows somewhat later. The German dialects spoken in the lower and more northern localities have long exhibited considerable differences from those spoken in the higher and more inland, thus giving rise to the distinction between High German and Low German. What is ordinarily called German (called *Deutsch* by the Germans) is High German. Low German includes Dutch, Frisian, &c. One of the earliest specimens of

Old High German is the oath of Charles the Bald, sworn at Strasbourg in 842. Middle High German became literary in the twelfth century, its poetry giving it a predominance as far as Austria. During the following century Suabian was the predominant dialect, and its influence is apparent in all the writings of the fourteenth and fifteenth centuries. Ultimately Upper Saxon became the language of literature and cultivated society in consequence of the translation of the Bible by Luther, which may be said to have fixed the New High German of modern times.

German Literature received its first impulse from the fondness of the early Germanic races for celebrating the deeds of their gods and heroes. According to Tacitus, the warriors would advance to attack chanting wild war-songs, with their shields held close to their mouths, which added to the discordant effect of the unknown and uncouth tongue. Of these early songs nothing even in a translated form has been handed down to us. The legends immediately connected with the Gothic, Frankish, and Burgundian warriors of the period of national migration—Dietrich (Theodoric), Siegfried, Hildebrand, &c.—have for the most part some historical foundation, and many of them were eventually incorporated in the *Nibelungenlied*, the most celebrated production of German mediæval poetry. On the introduction of Christianity was opened another sphere of literary activity. Metrical translations of the Evangelists, the *Krist* and *Ieliand*, appeared in the ninth century in the High and Low German dialects respectively. The *Ludwigshied*, a psalm in honour of the victory of Louis III, King of the Franks, over the Normans in 883, was composed in Old High German by a Frankish ecclesiastic. The preservation of the *Hildebrandlied* is also due to churchmen, who transmitted it partly in the High and partly in the Low dialect. The *Merseburger Gedichte*, two songs of enchantment written in the tenth century, throw light on the ancient religious beliefs of Germany; but in general the hostility of the clergy to the old pagan literature of heroic legends, beast-fables, &c., was not favourable to its preservation.

In the twelfth and thirteenth centuries poetry passed from the monasteries and ecclesiastical schools to the palaces of princes and the castles of nobles. Under the cultured emperors of the House of Hohenstaufen, the first bloom of German literature came. Many of the poets of this period were nobles by birth, some of them even princes. Heinrich von Veldeke was the first to introduce into his heroic poem *Enenit* that spirit of devotion to women called by the old Germans *Minne* (love, hence the name *Minnesänger*, love-minstrel). A still greater name is that of Wolfram von Eschenbach, the author of *Parzival*, a poem embodying the legends of King Arthur,

the Knights of the Round Table, and the *San Graal* (Holy Grail). These traditions, together with the exploits of Charlemagne, of Alexander the Great, and the Trojan heroes, inspired also the lays of Gottfried of Strassbourg, Hartman von der Aue, and others. These subjects were all taken from the romances of the French *trouvères*, and treated in a style closely resembling theirs. But we have besides real national epics in the *Nibelungenlied* and *Gudrun* (q.v.). The lyrics or minnesongs of this period are not less remarkable than its romances and epics. Perhaps the most gifted lyricist is the celebrated Walther von der Vogelweide. Next to him rank Heinrich von Ofterdingen, Reinmar der Alte, the Austrian poets Nithard and Tannhäuser. Several hundreds of these poets were engaged in travelling from palace to palace and from castle to castle. Their songs were mostly in the Suabian dialect, and the poets constituted what is called the Suabian school. In the thirteenth century didactic poetry began to be cultivated with some success. The dawn of historical literature is heralded by the *Limburg Chronicle* (1336-98) and the *Alsace Chronicle* (1386), but the age of chivalry, as Ulrich von Lichtenstein complained in his poem *Frauendienst*, was declining. During the troublous times of the Interregnum (1256-73) poetry passed to the homes of the private citizen and the workshops. These humbler poets formed themselves into guilds in the imperial cities—Nürnberg, Frankfurt, Strassbourg, Mainz, &c., and were called *Meistersänger*, in contradistinction to the knightly *Minnesänger*.

In the fourteenth century Germany produced several mystical theologians, disciples of Meister Eckhart, the most celebrated of whom were Tauler and Suso, whose sermons and writings paved the way, in some measure, for the Reformation. The only good poetry in the fourteenth, and up to the close of the fifteenth century, were the spirited lays of Halb Suter and Veit Weber, who celebrated the victories of Switzerland over Austria and Burgundy. The invention of printing caused an increasing literary activity, and the works printed in Germany between 1470 and 1500 amounted to several thousand editions. In 1498 there was published the celebrated beast-epic *Reineke Vos* (Reynard the Fox). Other popular works were the *Narrenschiff* (Ship of Fools) of Sebastian Brandt, an allegorical poem in which the vices are satirized; *The Satires of Thomas Murner*; and (in 1519) *Till Eulenspiegel*, a collection of humorous stories about a wandering mechanic.

In the sixteenth century a new era opens in literature with Luther's translation of the Bible. The writings of Luther, Zwingli (1484-1531), Sebastian Frank (1500-45?), Melancthon (1497-1560), Ulrich von Hutten (1488-1523), one of

the chief writers of the *Epistolæ Obscurorum Virorum*, constitute the principal theological literature of the Reformation. History was now written in a superior style, and with greater comprehensiveness, by Frank in the *Zeitbuch* and *Weltbuch*, and by Sebastian Münster (1489-1552) in his *Kosmographie*; also by Tschudi (1505-72) in *Chronicles of Switzerland*, and by Aventinus (1477?-1534), the Bavarian chronicler. The autobiography of Götz von Berlichingen also deserves mention as a sketch of the rude lives of the smaller nobility. Amongst the poets of this period Hans Sachs (1494-1576), the cobbler of Nürnberg, the greatest of the Meistersänger, and Johann Fischart (died 1589), a great satirist, and author of *Das glückhafte Schiff*, stand much above their contemporaries. Many of the hymns and religious lyrics of the age are of high merit, particularly those of Luther, Elber, Waldis, and others. The drama also made considerable progress, Hans Sachs, before mentioned, and Jakob Ayer (died 1605) being amongst the best writers in this department. But it was in learned and scientific treatises that the age was most prolific. Amongst the chief learned writers are Luther, Camerarius, Cornelius Agrippa, Paracelsus, Copernicus (astronomy), Leonhard Fuchs (botany and medicine), Conrad Gesner (zoology and classics), and Agricola (mineralogy).

By the beginning of the seventeenth century literature was on the decline. This century is known in German literature as the period of imitation. Most of the poets were graduates of universities; and learned societies were formed for the purpose of improving the language and literature. A new school of poetry, known as the first Silesian school, was founded, of which Martin Opitz (1597-1639) was the leader. His works are more remarkable for smoothness of versification than for true poetic inspiration. As a critic his work *Die Deutsche Poetere* became a kind of manual for verse makers. Amongst the chief members of the Silesian school were Simon Dach (1605-69), von Zesen (1619-89), Johann Rist (1607-67), and, greatest of all, Paul Fleming (1609-40), whose lyrics are natural and cheerful as the songs of a lark. Of this school also was Andreas Gryphius (1616-64), who may be said to have founded the regular German drama. The second Silesian school, headed by Hoffmann von Hoffmannswaldau (1618-79), and Lohenstein (1635-83), carried affectation to its utmost. Both the Silesian schools were opposed by the 'court poets', Canitz (1654-99), Besser (1654-1720), and many others who imitated the French school and took Boileau for their guide. Germany's greatest hymn-writer, Gerhardt (1606-76), belongs to this period. Amongst the best satirists and epigrammatists were Logau (1604-55) and Lauremberg (1591-1659). Amongst

novelists Moscherosch with his *Geschichte Philanders von Sittewald*, and Grimmelshausen in his *Simplicissimus* give graphic pictures of life during the Thirty Years' War. Among the scientific and philosophic writers of the period we may mention Kepler (1571-1631); Puffendorf (1632-94), the publicist; and Jakob Böhme (1575-1624), the great mystic, who stood almost alone in writing his books on philosophy in German. Leibnitz (1646-1716) was the first to lay a scientific basis for the study of philosophy, but his works were composed chiefly in French and Latin. Wolff (1679-1754), his disciple, shaped the views of his master into a comprehensive system, and published his works in the German language.

In the eighteenth century poetry revived with Haller (1708-77), remarkable as a descriptive poet, and Hagedorn (1708-54), a lyricist of considerable merit. The Saxon school, headed by Gottsched (1700-66), aimed at a reformation of German poetry, and modelled the drama as far as possible on the works of Corneille and Racine. These tendencies brought about a violent controversy with a group of writers in Zürich, known as the Swiss school, and headed by Bodmer and Breitinger, who took the English poets as their model, and laid stress on the function of imagination and feeling in poetry. The result of the controversy was that most of the young writers at Leipzig shook off the authority of Gottsched, and even established a periodical (*Die Bremer Beiträge*) in which the principles of their former master were attacked. Among the contributors were Rabener (1712-91), a popular satirist with a correct and easy style; Zachariä (1726-77), a serio-comic epic poet; Gellert (1715-69), the author of numerous popular hymns, fables, and a few dramas now forgotten; Kästner (1719-1800), a witty epigrammatist and talented mathematician; Giske, Cramer, Fuchs, Ebert, and many others of more or less note. To the school of Halle belonged Kleist (1715-59); Gleim (1719-1803), a celebrated fabulist; and others. Gessner of Zürich (1730-87) gained in his time a high reputation as a writer of idylls. With the writings of Klopstock (1724-1803) and Wieland (1733-1813) the classical period of German literature (usually reckoned from 1760) may be said to begin. Though the epic poem of the first (*Messias*) is no longer counted a poem of the first rank, yet Klopstock's work, with its ardent feeling for the spiritual and sublime, is recognized to have had a beneficent effect on German literature. Wieland, a striking contrast to Klopstock, awakened with his light and brilliant verse a greater sense of gracefulness in style. But it was reserved for Gotthold Ephraim Lessing (1729-81) to give a new direction to German literature. He established a new school of criti-

cism and dealt a fatal blow to French influence. His tragedy *Emilia Galotti*, his comedy of *Minna von Barnhelm*, and his philosophic drama *Nathan der Weise* were the best models of dramatic composition which German literature had yet produced, and his direction of the German mind towards Shakespeare and the English drama was not the least of the many impulses he contributed to the literary growth of his countrymen. Herder (1744-1803), with his universal knowledge and many-sided activity, followed Lessing as another great influence in the literary world. The researches of Winckelmann (1717-68) in ancient sculpture led to a new understanding of art, as those of Heyne in ancient literature mark the development of modern German scholarship. A union of the students at Göttingen University, where Heyne taught, gave rise to the *Göttinger Dichterbund* or *Hainbund*, among the members of which were Gottfried Aug. Bürger (1748-94), author of *Lenore* and other wild and picturesque ballads and songs; Voss (1751-1826), the translator of Homer, and author of one of the finest German idylls, *Luisie*; together with the two brothers Stolberg, Boie, Hölty, and Claudius.

This period was followed by a time of transition and excitement known in Germany as the *Sturm-und-Drang Periode* (Storm and Stress Period), which found its fullest expression in an early work of Goethe's (1749-1832), the *Sorrows of Werther*. The literary excitement was raised to the highest pitch by the *Räuber* (Robbers) of Schiller (1759-1805), afterwards the friend and coadjutor of Goethe. By the joint exertions of these two great men German literature was brought to that classical perfection which, from a purely local, has since given it a universal influence. Of a highly individual character are the works of Jean Paul Richter (1763-1825), a writer of profound humour and pathos; and Jung Stilling (1740-1817), whose autobiography holds a peculiar place in German literature for the charming *naïveté* of its thought and style. In the departments of science and philosophy, we have the names of Moses Mendelssohn (1729-86); A. G. Baumgarten (1714-62), the founder of the science of aesthetics; the historians Mosheim (1694-1755), Dohm, Möser, Spittler, Johannes Müller; Adelung the philologist; Basedow and Pestalozzi the educationists; Ernesti, Spalding, Rosenmüller, and Michaelis, theologians; Eichhorn in theology and universal and literary history; and the scientific writers Blumenbach, Euler, Vega, Herschel, and others. In the field of pure metaphysics Immanuel Kant was succeeded by Fichte (1762-1814), Hegel (1770-1831), and Schelling (1775-1854).

Partly produced by the influences of the *Sturm-und-Drang* period, and partly trained in the laws of art laid down and worked out by Goethe and

Schiller, the so-called *Romantic school*, distinguished by its enthusiasm for mediæval subjects and its love of what is mysterious and transcendental in life or thought, gradually succeeded in gaining public attention about this epoch. Amongst the principal writers of this school are von Hardenberg, better known as Novalis (1772–1801), a *pensée*-writer of deep poetic insight; Ludwig Tieck (1773–1853), a writer of tales, dramas, and dramatic criticisms; La Motte Fouqué, Clemens Brentano, Hoffmann, Musæus, Werner, von Kleist, &c. The two Schlegels (August Wilhelm, 1767–1845, whose translation of Shakespeare is still celebrated, and Friedrich, 1772–1829, best known by his philosophy of history) also belong to this school.

The War of Liberation against Napoleon I introduced a strong manly enthusiasm for a time into the hitherto gloomy and melancholy productions of the romanticists. Amongst the patriotic poets of the time Ernst Moritz Arndt (1769–1860) and Theodor Körner (1791–1813) hold the first place. The ballads and metrical romances of Ludwig Uhland (1787–1872) have brought him a world-wide fame. Friedrich Rückert (1780–1866) also may be noticed as a lyric poet of merit. During the excitement produced by the July Revolution in France (1830) a school of writers arose in whose works the social and political ideas of the time were strongly reflected. The most prominent names amongst this party are Ludwig Börne (1786–1837) and Heinrich Heine (1799–1856), whose writings combine the keenest satire and the finest pathos. Amongst the better-known members of the school is Karl Gutzkow (1811–78), a popular dramatist and novelist. As in England and France, the novel, especially the novel of a social or political character, has since taken a prominent place in German literature. Most distinguished are Freytag, Spielhagen, Heyse, Auerbach, Fanny Lewald, Hackländer, Reuter, Jensen, Storm, Rosegger, &c. Science and learning, just as literature and the arts, have produced also names of great eminence. Alexander von Humboldt (1769–1859) gave a great impulse to almost all branches of knowledge by his *Cosmos*, his *Travels*, and his *Views of Nature*, and by the general suggestiveness of his labours. In history, Niebuhr and Theod. Mommsen, the historians of Rome; Leopold Ranke, the historian of the Popes; Dahlmann, Gervinus, Sybel (*French Revolution*), Giesebrecht, Julian Schmidt, H. Kurz, and others may be mentioned. Biography has been well represented by Varnhagen von Ense, Pertz, David F. Strauss, and others. German modern theology and Biblical criticism has had lately much influence in the religious world. Baur, Bleek, and Ewald are among the widely-known names. Histories of art have been

written by Kugler, Burckhardt, Lübke, and others. The brothers Grimm — Jakob (1785–1863), and Wilhelm (1786–1859) — were the founders of a new branch of philological and poetic investigation in ancient German literature. Eminent names in general philological science are those of Bopp, Pott, Schleicher, Steintal, and Karl Brugmann. In natural sciences, Oken, Burmeister, Carus, Cotta, Liebig, Helmholtz, Virchow, Schleiden, Grisebach, Vogt, Bessel, Brehm, Häckel, Bastian, &c., are the eminent names; in philosophy, Schopenhauer, Feuerbach, Rosenkranz, Lotze, Kuno Fischer, von Hartmann, Nietzsche, &c. Amongst poets Anastasius Grün (pen-name of Count von Auersberg) and Nikolaus Lenau amongst Austrians, and Meissner and Hartmann, natives of Bohemia, have a considerable reputation. Hervegh, Hoffmann von Fallersleben, Freiligrath, and Franz Dingelstedt infuse strong political sentiments into their poetry. Emmanuel Geibel, von Scheffel, Bodenstedt, and others represent a poetry more comprehensive in its aims and tendencies.

Among the prominent novel-writers belonging to the generation following the Franco-Prussian War are Ebers, Dahn, Gottschall, Willbrandt, Paul Lindau, Baroness von Suttner, Anzengruber, Franzos, Sacher-Masoch, Clara Viebig, Thomas Mann, and others. The greatest modern German dramatists are Sudermann, Hauptmann, Halbe, Fulda, and Schnitzler. Among lyrical poets the most prominent are Liliencron, Dehmel, Busse, and Agnes Miegel. During the European War the literary activity of the German people, in spite of the stress of the war, was considerable. War books were published in great numbers, and there was quite a deluge of patriotic poetry. Defiance and self-righteousness were the characteristics of most German works published between 1914 and 1918. Whether a note of repentance will be introduced into German literature, and a moral renaissance inaugurated, still remains to be seen. — BIBLIOGRAPHY: J. G. Robertson, *History of German Literature*; Kuno Francke, *German Literature as determined by Social Forces*; J. F. Coar, *Studies in German Literature in the Nineteenth Century*; G. M. Priest, *Brief History of German Literature*; M. Geissler, *Führer durch die Deutsche Literatur des Zwanzigsten Jahrhunderts*; T. Dresch, *Le Roman social en Allemagne*; B. Taylor, *Studies in German Literature*; G. Brandes, *Main Currents in Nineteenth Century Literature*; C. Thomas, *History of German Literature*.

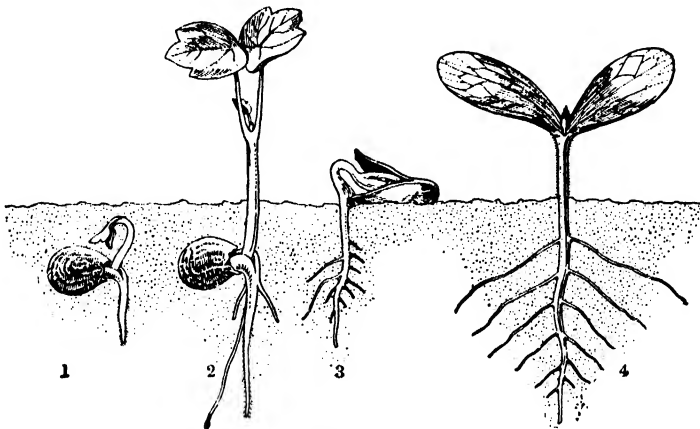
Germersheim (ger'mérz-him), a town and fortress in the Bavarian Palatinate, on the Rhine, 8 miles s.w. of Speier. In 1793 the French were defeated there by the Austrians. Pop. 5838.

Germinal Vesicle, in biology the nucleus of

the ovum or egg-cell. It contains within it a nucleolus called the *germinal spot*.

Germination, the first act of growth by an embryo plant. The immediate causes of germination are the presence of moisture and atmospheric air and a certain elevation of temperature. Moisture softens the integuments of the seed and swells the tissue of the embryo; atmospheric air supplies oxygen; and a temperature which must be at least as high as 32° F., by exciting the vitality of the embryo, enables it to take advantage of the agents with which it is in contact. During germination various changes take place in the chemical constituents of the seed; they

in the body of the diseased animal; (2) it must be capable of being isolated in pure culture outside the body (see *Bacteriology*); (3) when a pure culture is introduced into a healthy animal of the same species, the disease must be reproduced. All these conditions were fulfilled in the case of anthrax, and since 1877 evidence has been adduced for bacteria being the cause of the following diseases, each disease being associated with a special bacterium: inflammation and abscess formations (1881-4), erysipelas (1884), pneumonia (1886), epidemic cerebro-spinal meningitis (spotted fever) (1887), tuberculosis (1882), glanders (1882), typhoid fever



Germination

1, 2, Seedling of Nasturtium. 3, 4, Liberation of the cotyledons from the cavity of the seed of Gourd.

are usually accompanied by increase of temperature, as is seen in the process of malting. Along with these other changes commonly take place: a root is produced, which strikes perpendicularly downwards and, fixing itself in the soil, begins to absorb food; an upward growth of the plumule leads to the protrusion of a stem and leaves.

Germ Theory of Disease. This phrase came into use between 1860-77, and implied that certain diseases may result from the growth of bacteria in the body. The discovery that bacteria are the cause of putrefaction, and the success attending Lister's efforts to prevent blood-poisoning by excluding bacteria from surgical wounds, form the historical setting of the theory. The first absolute proof of its reliability was furnished when, in 1877, Koch showed that the bacillus anthracis was the cause of anthrax in cattle. Koch held that three conditions must be fulfilled before an organism could be accepted as the cause of a disease: (1) the organism must be invariably demonstrable by the microscope

(1880-4), bacillary dysentery (1898), diphtheria (1883-90), tetanus (1885-9), cholera (1884-93), plague (1894), and syphilis (1905).

While it is of course impossible in most cases of human disease to obtain absolute proof of the cause by injecting pure cultures of the suspected organism into man, there can be no reasonable doubt that the diseases cited are caused by the organisms associated with them. In other cases, e.g. rheumatic fever, whooping cough, and influenza, sufficient evidence is still wanting. The germ theory has thus been established on a firm basis, and probably the difficulties encountered in other infectious diseases (e.g. scarlet fever, measles, smallpox) will in time be overcome. In certain cases, although the infective agent is unknown, the means by which infection is carried has been proved: thus, in typhus fever the louse is the carrier, and in yellow fever a mosquito. One of the hindrances to further advance probably is that the infective agent is often excessively small; this is known to be the case in infantile paralysis. Work on

the germ theory has shed important light on the general phenomena of infectious disease. The causal organism usually gains access to man by the nose and mouth, more rarely through wounds (in bubonic plague infection is carried through the bites of fleas coming from infected rats, which also suffer from this disease); the former fact accentuates the significance of the sore throat which is so often the first symptom complained of.

Bacteria either multiply on some bodily surface and produce poisons which are absorbed (diphtheria), or they penetrate into the body and settle down in an organ for which they have a predilection (typhoid fever, pneumonia), from which they exercise their disease effects. The body resists their inroads; certain cells rush to the part and engulf and destroy the organisms, and a general mechanism throws substances into the blood which kill the bacteria or neutralize their effects (see *Antitoxin*). Exposure to infection is not invariably followed by disease. This may be due to the dose of the infective agent being too small, which emphasizes the desirability of infectious cases being placed in large airy rooms. It may also be due to many individuals being insusceptible to the infection. This points to the part played by the constitution of the person exposed, and it explains how such not obviously infectious diseases as tuberculosis and pneumonia are in reality due to an agent introduced into the body from outside.

The failure of bacteriology to account for the cause of malaria led to an important development of the germ theory, whereby it was shown that the protozoa—a much more highly organized group than the bacteria—could act as the agents of infection. Malaria was proved to be due to such a cause. The parasite undergoes a complicated asexual cycle of development in man, with which the symptoms of a malarial attack are associated. Direct infection from man to man does not occur; if, however, a mosquito sucks the blood of an infected man, the parasite goes through a sexual cycle in the insect, and, when the mosquito bites a fresh human subject, the rejuvenated protozoon is injected and a fresh case of malaria originated. Other protozoa cause sleeping sickness in man (the organism being carried by a biting fly), tropical dysentery, and the chronic ulcer known as Oriental sore. See *Antitoxin*; *Bacteria*; *Disinfection*; *Inoculation*, &c. — BIBLIOGRAPHY: R. Muir and J. Ritchie, *Manual of Bacteriology*; R. T. Hewlett, *Manual of Bacteriology*; A. Besson, *Practical Bacteriology*.

Gérôme (zhā-rōm), Jean Léon, painter, born in 1824 at Vesoul, France, died in 1904. He studied in Paris under Paul Delaroche. In 1854 he travelled in the East, which provided subjects

for some of his most popular pictures, such as *The Slave Market* (1867). In 1855 a large canvas, *The Age of Augustus and the Birth of Christ*, was purchased by the State, and was the first of a series of works on classical themes, including *Cæsar* (1859), *Phryne* (1861), *Le Roi Candaule* (1861), and *Socrates* (1861). The subject of these last three gave rise to much criticism. Among his historical pictures is *Louis XIV and Molière*; and he was also a successful sculptor, his *Bellona* (1892, in ivory, metal, and precious stones) attracting much attention. In 1863 he was appointed a professor at the École des Beaux Arts. He received the Prussian Order of the Red Eagle, and was a Commander of the Legion of Honour.

Gerona (hā-rō'nà), a fortified town of N.E. Spain, capital of the province of Gerona, in Catalonia, at the confluence of the Oña and the Ter, 52 miles north-east of Barcelona. It consists of an old and a new town, the former on the slope of a hill, with antiquated houses and a stately cathedral. There is spinning and weaving; also paper factories. Gerona was once the residence of the Kings of Arragon, and as a place of strategic importance has sustained many memorable sieges. Pop. 17,416.

Gerona, the province, area 2264 sq. miles, abuts on the Mediterranean, is mountainous and mostly rugged, but with many fertile valleys, which produce olives, wine, wheat, rye, &c., and all kinds of fruits and vegetables. Pop. 332,074.

Geropigia, or **Jerupigia** (je-ro-pi'ji-a, je-rup-i'ji-a), a mixture composed of unfermented grape-juice, with sufficient brandy and sugar to prevent it from fermentation, and colouring-matter from rhatany root or log-wood, imported from Portugal, to give spurious strength and colour to port wines.

Gers (zhār), a department in the south-west of France, separated from the Bay of Biscay by the department of Landes; area, 2428 sq. miles. The southern part is covered with ramifications of the Pyrenees separated by valleys, each of which is watered by its own stream. The chief of these are the Gers, Lasse, and Save. More than half the land is under the plough, and about a seventh is in vineyards. Much of the wine is made into Armagnac brandy. Auch is the capital. Pop. 194,406.

Gerson (zhār-sōn), Jean de, properly Jean Charlier, a celebrated French theologian, born at Gerson in 1363, died in 1429. He studied at the University of Paris, received the doctorate in 1392, and in 1395 became chancellor of the university. He was ardent and courageous in advocating improvements and reforms, but mostly only succeeded in making for himself powerful enemies. He is mainly remembered

in connection with his efforts to bring about a cessation of the great schism which had divided the Church since 1378. His proposal was to depose both the rival Popes and elect a third in their room—a step which was actually taken by the Council held at Pisa in 1409, of which Gerson was a member as deputy of the University of Paris. This proceeding, however, was a failure, the only result being that there were three rival Popes instead of two. When the Council of Constance (1414–8), in which also Gerson took a leading part, likewise proved unable to settle the differences existing in the Church, he at last gave up the struggle in despair, and not daring to return to France, where his enemies had then the upper hand, sought shelter for a time in Bavaria and Austria. In 1419 he returned to his native country, and spent the last ten years of his life with his brother, the prior of a community of Celestine monks at Lyons, living an ascetic life, and devoting himself to religious meditation and the composition of theological and other treatises. The authorship of the *Imitation of Christ*, by Thomas-a-Kempis, was at one time erroneously ascribed to him.—Cf. M. Creighton, *History of the Papacy*.

Gerstäcker (ger'stek-ër), Friedrich, a German traveller and novelist, born at Hamburg 1816, died in 1872. In 1837 he went to America, where he earned a living by the most various employments—as a sailor, stoker, innkeeper, woodcutter, and trapper and hunter in the prairies of the west. He returned to Germany in 1843, and began his literary life by the publication of his experiences in America, *Streif- und Jagdzüge durch die Vereinigten Staaten Nordamerikas* (Dresden, 1844). This was followed by *Die Regulatoren in Arkansas, Die Flusspiraten des Mississippi, and Mississippibilder*. In 1849 Gerstäcker was engaged on behalf of the German Government to collect information which might be useful to German emigrants. The results were published under the title of *Reisen* in 1853. He afterwards made voyages to South America, to Egypt, the West Indies, and other places, which are described in his *Neue Reisen* (1868). Amongst his many romances (most of which may be had in English) are: *Die beiden Sträflinge* (1856), *Im Busch* (1864), *General Franco* (1865), *Californische Skizzen* (1856), and others.

Gerund, the name given originally to a part of the Latin verb which possesses the same power of government as a verb, but also resembles a noun in being governed by prepositions. In early English or Anglo-Saxon a dative form of the infinitive is used to indicate purpose, and is often called the gerund. In modern English what seems to be a present participle governed by a preposition is sometimes called a gerund, in such phrases, for example, as 'sit for teaching'; but

this is merely a verbal noun representing the old Anglo-Saxon noun in *-ung*.

Gervaise, or **Gervase**, a monk of Canterbury, born in 1150. Amongst his writings is an important chronicle, *Chronica de tempore regum Angliæ, Stephani, Henrici II et Ricardi I*. It is reprinted in Twysden's collection. He also wrote *Gesta Regum*, and *Mappa Mundi*, a survey of the counties of England. Gervaise died probably about 1200.

Gervaise (or **Gervase**) of **Tilbury**, a chronicler of the twelfth and thirteenth centuries, born at Tilbury, in Essex, about the middle of the twelfth century. He appears to have spent most of his life on the Continent, living in France, Sicily, Italy, and elsewhere. He taught law at Bologna for a time, and was in the service of the Emperor Otto IV, by whom he was appointed to the post of Marshal of the Kingdom of Arles. He died, according to some, in 1218. His chief and only extant work is entitled *Otia Imperialia*. Its contents are of a very varied character, including facts pertaining to geography, natural history, and superstitions, besides an account of the history of Britain and of the English kings down to his own time.—Cf. W. Stubbs's edition of *Gervase of Canterbury* (Rolls Series, 1879–80).

Gervex, **Henri**, French painter, born in Paris 10th Dec., 1852, died 1913. He studied under Fromentin, Cabanel, and Brisset, and first exhibited in 1873. Gervex started by painting mythological subjects and the nude. Devoting himself afterwards to representations of modern life, he achieved considerable success, and was entrusted with the execution of several official decorative paintings for public buildings. Among his works are: *Satyr playing with Bacchante* (1874), *Diana and Endymion* (1875), *Return from the Ball* (1879), *Civil Marriage* (1881), *First Communion* (1884), *Meeting of the Jury on Painting* (1885), *The Coronation of Nicholas II* (1896), *The Mayors' Banquet* (1900), &c. He also painted the ceilings for the Salle des Fêtes at the Hôtel de Ville, Paris.

Gervinus, **Georg Gottfried**, a German critic and historian, born at Darmstadt 20th May, 1805, died in 1871. He quitted commerce in 1825 to study at Heidelberg, was for some time a teacher, and qualified as a privat-docent. After a visit to Italy he published his *Geschichte der Poetischen Nationalliteratur der Deutschen* (History of the Poetic National Literature of the Germans, 1835–42). In 1835 he was appointed extraordinary professor at Heidelberg, and the following year ordinary professor of history and literature at Göttingen; but in 1837, being one of the seven professors who protested against King Ernst August's breach of the Constitution, he was banished from Hanover. After another visit to Italy he returned to Heidelberg, where

in 1844 he was appointed an honorary professor. He now began to take an active part in politics on the liberal side; became editor of the newly-founded *Deutsche Zeitung*, and was returned to the Federal Diet by the Hanse towns. Discontented with the tendency of affairs after 1848, he gave up politics and resumed his old studies. In 1849 he published the first part of his large work on Shakespeare, in 1853 his *History of German Poetry*, and in 1855 the first volume of his *History of the Nineteenth Century*, which, however, was never carried further than the French Revolution of 1830. Amongst his last writings was a critical essay, *Handel and Shakespeare*.

Gese'n'ius, Friedrich Heinrich Wilhelm, a German Orientalist and Biblical critic, born in 1786, died in 1842. He studied at Göttingen, and became professor of theology at Halle. Between 1810 and 1812 his *Hebrew and Chaldee Dictionary of the Old Testament* appeared. In 1820 he visited Paris and Oxford for the purpose of collecting materials regarding the Semitic languages. In 1829 he published his large *Thesaurus philologico-criticus Linguae Hebraicae et Chaldaicae*, completed in 1858 by Rödiger. Besides the works mentioned, Gesenius wrote a *Hebrew Grammar*, a *History of the Hebrew Language*, and notes to the German translation of Burckhardt's *Travels in Syria and Palestine*.

Gesner (ges'nér), Konrad von, German scholar, born at Zürich in 1516, died in 1565. He studied at Strasbourg, Bourges, and Paris, and became schoolmaster in his native town. Hoping to raise himself from his needy condition, he went to Basel, and devoted himself particularly to the study of medicine. Afterwards he became successively professor of Greek at Lausanne, and of philosophy at Zürich, and did important work in the departments of history, zoology, and botany. Gesner's *Historia Animalium* must be regarded as the foundation of zoology; and in botany he was the inventor of the method of classifying the vegetable kingdom according to the characters of the seeds and flowers. His *Bibliotheca Universalis* is a descriptive catalogue of all writers extant in Greek, Latin, and Hebrew. He died of the plague at Zürich.

Gesnera'ceæ, an order of gamopetalous Dicotyledons, typical genus *Gesnera*, named in honour of Konrad von Gesner. There are many species, mostly natives of tropical and subtropical regions. They are shrubs or herbs, often with tuberous rhizomes, and scarlet, violet, or blue flowers. Some of the genera are frequent in our hothouses, such as *Gloxinia*, *Achimenes*, and *Gesnera*.

Gessner (ges'nér), Salomon, a Swiss poet and artist, was born at Zürich in 1730, died there 1788. In 1749 he was sent by his father to learn

the business of bookselling at Berlin, but, having taken a dislike to the business, he maintained himself by executing landscapes, mainly in water-colour. On his return to Zürich he published *Daphnis*, a small volume of idylls, and *Der Tod Abels* (The Death of Abel), a kind of pastoral idyll in prose, for which he etched several plates of ornaments. His *Idylls* appeared in English in 1798. These idylls acquired for him a great reputation amongst contemporaries. For some years afterwards he devoted himself to engraving, chiefly after pictures by Claude and Poussin.

Gesta Romano'rum ('Deeds of the Romans'), the usual title of a collection of short tales, legends, &c., in Latin, very popular during the Middle Ages. The book was probably written about the close of the thirteenth century by a certain monk Elinandus, an Englishman or a German. The separate tales making up the *Gesta* are of very various contents, and belong to different times and countries, the sources from which they are derived being partly classical, partly Oriental, and partly Western. Whatever may have been the intention of the original compiler, they very soon were adapted to the moralizing tendencies of the time, and moral reflections and allegorical interpretations were added to them, it is said, by a Petrus Bercegius or Pierre Bercaire of Poitou, a Benedictine prior. The stories were very widely read and gave plots (directly or indirectly) to Gower, Chaucer, and Shakespeare. After the Reformation the book fell into oblivion. There is an edition by Oesterley (1804), and a translation by C. Swan.

Gestation (Lat. *gestare*, to bear), in physiology, the name given to the interval which elapses between the impregnation of any of the mammalia and the period of birth. This period varies from 25 days in the case of the mouse, to 620 in that of the elephant.

Getæ (Gr. *Getai*), an ancient people of Europe, dwelling at first in Thrace; afterwards a part of them moved west on the north bank of the Danube, where they were known to the Romans as the *Daci*. (See *Dacia*.) Another portion moved east into Asia.

Gethsemane (the Hebrew for 'oil-press'), an olive garden or orchard in the neighbourhood of Jerusalem, memorable as the scene of the last sufferings of our Lord. The traditional site of this garden lies towards the east side of the city, a very little beyond the Kedron, near the base of Mt. Olivet. It contains some very old olive trees, piously regarded as having stood there in the time of our Lord. Excavations carried on in the garden of Gethsemane in 1920 led to the discovery of interesting remains dating back to the fourth century.—Cf. W. Sanday, *Sacred Sites of the Gospels*.

Gettysburg, the capital of Adams County,

Pennsylvania. The Pennsylvanian College (Lutheran), founded in 1832, is there, as are the national cemetery for Union soldiers, and a national homestead for the orphans of Union soldiers. At Gettysburg a battle was fought (1st, 2nd, and 3rd July, 1863) between the Union forces under General Meade and the Confederate forces under General Lee, in which the latter suffered a disastrous defeat.

Geum (jé'um), a genus of hardy herbaceous perennials, belonging to the nat. ord. Rosaceæ, chiefly natives of the northern parts of the world. Two of them are common British plants—*G. urbānum*, wood-avens or herb-bennet, and *G. rivāle*, water-avens (found also in Asia and North America). *G. canadense*, chocolate-root, or blood-root, a North American species, has some reputation as a tonic.

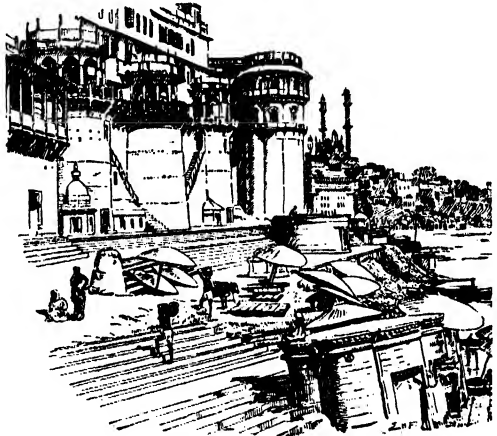
Geysers, a slight alteration of the Icelandic name *geysir*, from *geysa*, to gush or rush forth, and applied to explosive springs of hot water of the kind that were first observed in Iceland. The geysers of Iceland, about a hundred in number, lie about 30 miles north-west of Mount Hecla, in a plain covered by hot springs and steaming apertures. The two most remarkable are the Great Geyser and the New Geyser, the former of which throws up at times a column of hot water to the height of from 80 to 200 feet. The basin of the Great Geyser is about 70 feet across at its greatest diameter. The New Geyser, which is only 100 yards distant, is much inferior in size. The springs are supposed to be connected with Mount Hecla, and the phenomenon of eruption has been explained by Tyndall as due to the heating of the walls of a fissure, whereby the water is slowly raised to the boiling-point under pressure of superincumbent water, and explodes into steam, an interval being required for the process to be repeated. The geysers of Iceland, however, have been surpassed by those discovered in the Rocky Mountains in the Yellowstone Region of Wyoming, the largest of which throw up jets of water from 90 to 250 feet high. (See *Yellowstone*.) The hot-lake district of Auckland, New Zealand, is also famous in possessing some of the most remarkable geyser scenery in the world. These phenomena are of three kinds: the puias (fire-springs), geysers continually or intermittently active; ngawhas, or inactive puias, which emit steam, but do not throw up columns of water; and waiariki or hot-water cisterns. This region, prior to the Tarawera eruption of 1886, was remarkable for the number of natural terraces containing hot-water pools or cisterns, and for its lakes filled at intervals by the boiling geysers and thermal springs, and large quantities of steam are still emitted from the sites of the terraces of Rotomahana. Ngahapu or Ohopia,

a circular rocky basin, 40 feet in diameter, in which a violent geyser is constantly boiling up to the height of 10 or 12 feet, emitting dense clouds of steam, is one of the natural wonders of the southern hemisphere. Geysers frequently form cones and terraces of silica brought up in solution in their waters, and traces of gold and cinnabar occur in some of the deposits.—Cf. Malfroy, *On Geyser Action at Rotorua*.

Ghadames (ghā-dā'mes), a town of North Africa, in the south-west of Tripoli. It is about 310 miles south-west of the town of Tripoli, is situated in the midst of an oasis, and is the centre of caravan routes to Tunis, Tripoli, &c. Figs, dates, barley, and wheat are grown in the gardens, which are watered by a hot spring. Pop. about 10,000.

Ghara, or **Garra**, a river in the Punjab, being the name by which the united streams of the Bias and Sutlej are known, from their confluence at Endrisa to the junction with the Chenab, after which the united waters flow under the name of the Punjnad to the Indus. Length, about 300 miles.

Ghâts (gûts), or **Ghauts**, a Hindu term employed to designate landing-stairs on a river,



Ghâts at Benares

especially when large and substantially constructed. These ghâts are very numerous on the Ganges, and are great places of resort for the people of the towns where they are situated. Some of them are noteworthy from an architectural point of view, having temples, bathing-houses, &c., at the top.—Cf. E. B. Havell, *Indian Architecture*.

Ghâts, or **Ghauts**, **Eastern and Western**, two ranges of mountains in the peninsular portion of Hindustan, the former running down the east side of India, but leaving broad tracts

between their base and the coast; the latter running down the west side, but leaving only a narrow strip between them and the shore. Both meet near Cape Comorin. The general elevation of the Western Ghâts varies from 4000 to 7000 feet. Its best-known portion is the Nilgherries, with Dodabetta Peak, their highest point, 8760 feet above the sea. The Western Ghâts form a water-shed, and the rain collected on its eastern slopes makes its way right across India to the Bay of Bengal. They are covered with fine forests, and have most picturesque scenery. The Eastern Ghâts are of considerably less elevation, on the average about 1500 feet, and have none of the beauty of the western range. They are, however, rich in metals.

Ghazipur, a town in Hindustan, headquarters of the Ghazipur District, in the United Provinces, about 44 miles north-east of the town of Benares. It stretches along the banks of the Ganges; has a trade in sugar, tobacco, rose-water, and otto of roses; and is a healthy place. The ruins of the Palace of the Forty Pillars, and a monument by Flaxman to Lord Cornwallis, who died there in 1805, are there. Pop. 40,000.—The district, one of the hottest and dampest in the north-west, has an area of 1473 sq. miles, and a pop. of 1,077,909.

Ghazna, **Ghuznee**, or **Ghizni**, an ancient and celebrated city and fortress in Afghanistan, 84 miles s.s.w. of Kabul, on an eminence 7726 feet above sea-level. The wall embraces the whole of the hill; the houses are of mud; the streets dark, narrow, and irregular. The country round Ghazna is very productive in grain, fruits, and tobacco. Three miles north-east are the ruins of the ancient city, which, under the celebrated Sultan Mahmud (999–1030) (see *Ghaznavides*), was the capital of a great empire. It has been twice taken by British forces (1839 and 1842).

Ghaznavides (-vidz), a dynasty of twenty-one rulers, founded in 961 by Alp-Tigin, originally a slave belonging to the Ameer of Bokhara. Ghazna was the seat of his power, and became, under his successors, the capital of an empire which reached from the Tigris to the Ganges, and from the Sihon to the Indian Ocean. The most brilliant period of the dynasty was that of Sultan Mahmud (999–1030). It became extinct towards the end of the twelfth century after having lost most of its possessions.

Ghee (gē), or **Ghi**, a peculiar kind of butter in use among the Hindus. It is made from the milk of the buffalo or the cow. The milk is boiled for an hour or so, and cooled, after which a little curdled milk is added. Next morning the curdled mass is churned for half an hour; some hot water is then added, and the churning continued for another half-hour, when the butter forms. When, after a few days, it becomes rancid,

it is boiled till all the water is expelled, and a little more curdled milk added with some salt or betel-leaves, after which it is put into pots. In this state it will keep for a long time. It is too strong for European taste, but is a favourite article of consumption amongst rich Hindus.

Gheel (gāl), a village and commune in Belgium, 26 miles E.S.E. of the city of Antwerp and in the province of that name. It is situated in a fertile spot in the midst of a sandy waste, and is inhabited by a class of peasant farmers. It has manufactures of cloth, hats, wax and tallow candles; tanneries, dyeworks, ropeworks, and a considerable trade in butter. The commune has been long remarkable for containing a colony of insane persons, numbering at present about 1300, who are lodged and boarded in the houses of the country people, who make use of their services, when available, in field and other labour. Little or no restraint is employed, and the results are satisfactory. Recently a hospital has been erected, with a medical staff, for the supervision of the relations between the insane and their custodians. Patients are sent hither from all parts of Belgium. Pop. 13,470.

Ghent (gent; Fr. *Gand*; Fl. *Gend* or *Gent*), a city in Belgium, capital of the province of East Flanders, in a fertile plain at the confluence of the Lys with the Scheldt. It is upwards of 6 miles in circumference, and is divided by canals into a number of islands connected with each other by bridges. Except in some of the older parts it is well built, and has a number of fine promenades and many notable buildings. Amongst the latter are the cathedral of St. Bavon, a vast and richly-decorated structure, dating from the thirteenth century; the church of St. Nicholas, the oldest in Ghent; the church of St. Michael, with a celebrated *Crucifixion* by Vandyck; the university, founded in 1816, a handsome modern structure, with a library of about 300,000 volumes and 2500 MSS.; the Hôtel de Ville; the Belfry, a lofty square tower surmounted by a gilded dragon, and containing a fine set of chimes consisting of forty-four bells, one of which is the famous 'Roland of Ghent'; the new Palais de Justice; the Marché du Vendredi, an extensive square, interesting as the scene of many important historical events; and Les Béguinages, extensive nunneries founded in the thirteenth century, the principal occupation of whose members is lace-making. Ghent has long been celebrated as a manufacturing town, especially for its cotton and linen goods and lace. Other industries of importance are sugar-refining, hosiery, thread, ribbons, instruments of steel, carriages, paper, hats, delft-ware, and tobacco. There are also machine-works, engine-factories, roperies, tanneries, breweries, and distilleries. Ghent is famous for its nurseries and

flower traffic. The general trade is large. A canal that admits large sea-going vessels connects the town with the Scheldt at Terneuzen, but is less used than it might be on account of the heavy imposts levied by Holland on vessels passing through. Another canal connects the Lys with the canal from Bruges to Ostend. Pop. (1920), 165,655. Ghent is mentioned as a town in the seventh century. In the ninth century Baldwin, the first Count of Flanders, built a fortress there to check the Normans. Under the Counts of Flanders Ghent continued to increase, and in the fourteenth century could send 50,000 men into the field. The wealth and liberty of its citizens disposed them to a bold maintenance of their privileges against the encroachments of feudal lords like the Dukes of Burgundy and the Kings of Spain. Two great revolts took place under the leadership of the van Artevelde (1338 and 1369) against Burgundy, and again in the sixteenth century against Charles V. But by this time the great municipalities of the Middle Ages were decaying in power and vigour, and the citizens of Ghent, besides losing their privileges, had to pay for the erection of a citadel intended to keep them in bondage. In 1792 the Netherlands fell under the power of France, and Ghent became the capital of the department of Escaut (Scheldt). In 1814 it became, along with Flanders, part of the Netherlands, till the separation of Belgium and Holland. Ghent was the birth-place of Jacob van Artevelde and of John of Gaunt, or Ghent. The Treaty of Ghent between Great Britain and the United States was signed on 24th Dec., 1814. During the European War Ghent was occupied by the Germans in Oct., 1914, and remained in their possession until 11th Nov., 1918.

Gherardesca (gā-rār-des'kà), a family of Tuscan origin which plays an important part in the history of the Italian republics of the Middle Ages. Historically the most prominent member of the family is Ugolino, whose death, and that of his two sons and grandsons, by starvation in the 'Tower of Hunger', is described in one of the celebrated passages of Dante's *Divina Commedia*. Ugolino had made himself master of Pisa, and had behaved in the most cruel and arbitrary manner for four years, when, in 1288, he was overthrown by a conspiracy.

Ghetto (get'to), a name used in different towns of Italy, Germany, and other countries to indicate the quarter set apart for the residence of Jews. The first Ghetto was that of Rome, in the time of Pope Paul IV, who compelled the Jews to dwell in a quarter set apart for them on the left bank of the Tiber.

Ghibellines (gib'el-linz), the name of a political party in Italy which, in general, favoured the claims of the emperor against those of the

Pope. The name is said to be derived from Waiblingen a small estate belonging to the Hohenstaufen princes. See *Guelphs and Ghibellines*.

Ghiberti (gē-ber'tē), Lorenzo, Italian statuary, born about 1378 at Florence, died about 1455. From his stepfather Bartoluccio, an expert goldsmith, he learned the arts of drawing and modelling, and that of casting metals. He was engaged in painting frescoes at Rimini, in the palace of Pandolfo Malatesta, when the priori of the society of merchants at Florence invited artists to propose models for one of the bronze doors of the baptistry of San Giovanni. The judges selected the works of Donatello and Ghiberti as the best (according to Vasari, also that of Brunelleschi, who is not mentioned by Ghiberti himself as one of the competitors); but the former voluntarily withdrew his claims, giving the preference to Ghiberti. After twenty-one years' labour Ghiberti completed the door, and, at the request of the priori, executed a second, after almost as long a period. Michael Angelo said of these, that they were worthy of adorning the entrance to Paradise. During these forty years Ghiberti also completed other works, bas-reliefs, statues, and some excellent paintings on glass, most of which may be seen in the cathedral and the church of Or San Michele at Florence.—Cf. Vasari, *Lives of the Painters*.

Ghilan (gi-làn'), a province of Persia, on the south-west shore of the Caspian Sea; area, about 5000 sq. miles. The lofty range of the Elburz Mountains forms its southern boundary. The whole province, except where cleared for cultivation and on the mountain summits, is covered with woods, and the excessive rain and dense vegetation render much of the level country a morass. The climate is consequently unhealthy. The province is rich in metals and very fertile. The capital is Resht. Pop. about 150,000.

Ghirlandaio (gir-làn-dä'yō), or **Corradi**.—(1) Domenico, Florentine painter, born at Florence in 1440, died 1494. He was the son of a goldsmith known as Il Ghirlandaio (the garland-maker) from his skill in making metal garlands. Important frescoes by him are in the Sistine Chapel at Rome and in S. Trinità and S. Maria Novella at Florence, where also he is well represented in the Uffizi and the Academy. He was fond of introducing contemporary portraits into his work. He was distinguished by fertility of invention, and by closer approximation in his work to normal external appearance than his predecessors, but lacks their power of giving his figures dignity and vitality, and is less of a colourist.—(2) Ridolfo (1483–1560), son of Domenico, strongly influenced by Raphael, one of the most popular Florentine painters of the

day, who, in addition to portraits and decorations for churches, produced many large scenic canvases for public festivals.

Ghost-moth, a nocturnal lepidopterous insect (*Hepidus humuli*), so called from the male being of a white colour, and from its habit of hovering with a pendulum-like motion in the twilight over one spot (often in churchyards), where the female, which has grey posterior wings and red-spotted anterior wings, is concealed.

Ghur, or **Ghor**, a mountainous district of Afghanistan, lying to the south of Herat, and of some importance in the history of the country. This district was the original seat of the second Mohammedan dynasty in Hindustan, the princes of Ghur, who, in the eleventh and twelfth centuries, included in their kingdom of Ghur, Afghanistan, Lahore, Sind, and Khorasan.

Gianibelli, or **Giambelli** (jān-i-bel'le, jām-bel'le), Federigo, an Italian military engineer, born at Mantua about 1530. After having offered his services to Philip II of Spain, who received him coldly, he went to England, where Elizabeth gave him a pension and sent him to help the Netherlands in their defence of Antwerp against the Spaniards (1585). Here he made himself famous by the damage which his inventions did to the enemy. After this he returned to England, where he fortified the coast-line against the Spanish invasion, and suggested the use of fire-ships, which was so disastrous to the Armada. He is supposed to have died in London, but the date of his death is unknown.

Giannone (jān-ō'nā), Pietro, Italian author, born in 1676, died in 1748. He studied law in Naples, and after winning a high place as an advocate, retired to give himself up to the execution of his great work, the *Storia civile del regno di Napoli* (1723). The severity with which Giannone treated the Church, and the attacks which he made on the temporal power of the Popes, drew upon him the persecutions of the court of Rome, and of the clergy in general. The offensive publication was burned, and the author excommunicated. Giannone therefore quitted Naples, 1723, and took refuge in Vienna, where, for a time, he was protected by the influence of powerful friends, but had ultimately to leave and betake himself to Venice in 1734. Expelled from Venice by the suspicious republic, he finally took refuge in Geneva. Here he wrote his *Il Triregno*, a bitter attack on the Papal pretensions. In 1736, having been enticed by a Government emissary to enter the Sardinian States, he was seized and imprisoned in the citadel of Turin, where he died.

Giants (Fr. *géant*; Gr. *gigas*, giant), people of extraordinary stature. History, both sacred and profane, makes mention of giants, and even of races of giants, but this in general occurs

only at an early stage of civilization, when the national mind is apt to exaggerate anything unusual. Hence the Cyclopes and Læstrygones of the ancients and the Cornish and Welsh giants of English folk-lore. The first mention of giants in the Bible is in *Gen.* vi, 4, where the Hebrew word used is *nephilim*, a word which occurs in only one other passage, where it is applied to the sons of Anak, who dwelt about Hebron, and who were described by the terrified spies as of such size that compared with them they appeared in their own sight as grasshoppers. A race of giants called the Rephaim is frequently mentioned in the Bible, and in *Gen.* xiv and xv appear as a distinct tribe, of whom Og, King of Bashan, is said to have been the last. Other races of giants are mentioned, such as the Emim, the Zuzim, and the Zamzummim. The giants of old Greek or of Norse mythology have, of course, merely a symbolic existence, representing benignant or adverse forces of nature on which man might count in his struggle to reduce the world around him into some kind of order. The gigantic stature attributed to these supernatural beings in mythology is merely a method of expressing their extraordinary power. The tales of old writers regarding gigantic human skeletons have now no importance, it being well established that these bones do not belong to giants, but to animals of the primitive world which, from ignorance of anatomy, were taken for human bones. The ordinary height of men is between 5 and 6 feet; amongst the Patagonians of South America, however, the average seems to be considerably higher, though they are not a race of giants. Notable deviations from the medium heights are not at all uncommon, especially among the Teutonic peoples. The following are amongst recorded instances, ancient and modern, of persons who attained to the stature of giants: the Roman Emperor Maximin, a Thracian, nearly 9 feet high; Queen Elizabeth's Flemish porter, 7 feet 6 inches; C. Munster, a yeoman of the guard in Hanover, who died in 1676, 8 feet 6 inches high; Cajanus, a Swedish giant, about 9 feet high, exhibited in London in 1742; C. Byrne, who died in 1783, attained the height of 8 feet 4 inches; Patrick Cotter O'Brien, who lived about the same time, was 8 feet 7½ inches; a Swede in the celebrated grenadier guard of Frederick William I of Prussia stood 8½ feet. In 1884 died Pauline Wedde (called Marian), over 8 feet 2 inches at the age of eighteen. The following were exhibited in more recent times: Anna Swan, a native of Nova Scotia, above 8 feet high; her husband, Captain Bates (died 12th Jan., 1919), a native of Kentucky, of the same height; Chang-wu-gon, the Chinese giant, 7 feet 9 inches high. As a rule giants are comparatively feeble in body and mind, and are short-lived.

Gigantic stature is generally accompanied by a want of proportion in parts, some parts growing too quickly for others, or continuing to grow after the others have ceased. The relation between the upper and lower half of the body is not disturbed; but the skull, brain, and forehead are relatively small, the jaws very large, the shoulders, breast, and haunches very broad, and the muscular system comparatively weak. Recent research in clinical medicine has revealed the fact that most of these cases of 'giantism' are pathological. Disease of a curious appendage of the base of the brain, known as the pituitary gland, causes an abnormal growth of the bones and connective tissues, especially of the hands and feet and of the face (especially the jaws), giving rise to a condition known as acromegaly.

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Giant's Causeway, a promontory of columnar basalt on the north coast of Ireland, in the county of Antrim, between Bengore Head and Portrush. The name is sometimes given to the whole range of basalt cliffs along the coast, some of which reach the height of 400 or 500 feet; but it is more properly restricted to a small portion of it where a platform of closely-arranged basalt columns from 15 to 36 feet in height runs down into the sea in three divisions, known as the Little, the Middle, and the Grand Causeway. The last is from 20 to 30 feet wide, and stretches some 900 feet into the sea. The Giant's Causeway derives its name from the legend that it was built by Finn MacCoul as a road which was to stretch across the sea to Scotland. There are similar formations on the west coast of Scotland, on the Island of Staffa.

Glaour (jour), a Turkish word from Persian *gawr*, an infidel, used by the Turks to designate the adherents of all religions except Mohammedan, more particularly Christians. The use of it is so common that it is often applied without intending an insult. *The Glaour* is the title of a narrative poem by Lord Byron (1813).

Gibbon, Edward, English historian, was born at Putney, in Surrey, 27th April, 1737, died 16th Jan., 1794. The son of a gentleman of an ancient Kentish family, he entered Magdalen College, Oxford, where he remained fourteen months. Having declared himself a Roman Catholic, his father placed him under the care of M. Pavilliard, a learned Calvinistic minister at Lausanne, by whom he was reconverted to the Protestant faith. His residence at Lausanne was highly favourable to his progress in knowledge and the formation of regular habits of study. The belles-lettres and the history of the human mind chiefly occupied his attention. In 1758 he returned to England,

and immediately began to lay the foundation of a copious library; and soon after composed in the French language his *Essai sur l'étude de la littérature* (1761). In 1763 he visited Paris and Lausanne, and during 1764 he journeyed in Italy. It was here that the idea of writing his great history occurred to him as he sat musing among the ruins of the capitol at Rome, while the bare-footed friars were singing vespers in the Temple of Jupiter. In 1770 he published a pamphlet entitled *Critical Observations on the Sixth Book of the Æneid*. In 1774 he obtained a seat in Parliament for Liskeard, and was a silent supporter of the North administration and its American politics for eight years. In 1776 the first quarto volume of his *Decline and Fall of the Roman Empire* was published, and at once made a public reputation for its author. In 1778 he drew up on behalf of the English Government a *Mémoire Justificatif* in answer to the manifesto of the French court, and for this service he was made one of the Lords of Trade. On the retirement of North he lost his appointment, and soon after withdrew to Lausanne (1783), where, in the course of four years, he completed the three remaining volumes of his history, which were published together in 1788. In 1793 he returned to England, where he died in the following year. Gibbon's history, though not without its defects, has great merits. Its style, if at times somewhat monotonous, has the energy and elevation required for so great a theme; his learning is vast and thorough, and his insight into human nature in every variety of circumstances in remote countries and epochs is that of a great and philosophical historian. In 1796 his friend Lord Sheffield published two quarto volumes of his miscellaneous works, of which the most valuable part is the *Memoirs of his Life and Writings*. The best edition of the *Decline and Fall* is that of Bury (1909-12).—BIBLIOGRAPHY: J. A. C. Morison, *Gibbon* (in English Men of Letters Series); Prothero (editor), *The Letters of Gibbon*.

Gibbon, a name common to the apes of the genus *Hylobates*, but more particularly applied to the species *Ilyobates lar*, which inhabits the islands of the Indian Archipelago. It is distinguished from other man-like apes by the slenderness of its form, but more particularly by the extraordinary length of its arms, which, when the animal is standing, reach nearly to the ankles, and which enable it to swing itself from tree to tree with wonderful agility. Its colour is black, but its face is commonly surrounded by a white or grey beard.

Gibbons, Grinling, an English wood-carver and sculptor of Dutch origin, born 1648, died 1721, employed by royalty, and by most of the nobility of his time, to execute carvings in their

houses and for churches. A ceiling at Petworth is among his most remarkable works.

Gibbons, Orlando, English musical composer, born in 1583, died in 1625. At the age of twenty-one he was appointed organist of the Chapel Royal, and in 1622 he received the degree of Doctor of Music from the University of Oxford. Three years later he died of smallpox at Canterbury, where he had gone to be present at the marriage of Charles I with Henrietta of France. He was buried in Canterbury Cathedral, where his wife caused a magnificent tomb to be erected to him. He is the author of madrigals and



White-handled Gibbons (*Hylobates lar*)

anthems (*Hosanna to the Son of David! Almighty and Everlasting God!*) and other works.

Gibbs, Sir Philip Hamilton, K.B.E., British novelist and war correspondent, born in 1877. Editor with Messrs. Cassell & Co. at the age of twenty-one, he entered journalism in 1902, and was successively on the staff of *The Daily Mail*, *The Tribune*, and *The Daily Chronicle*. He was war correspondent with the Bulgarian army in 1912, and with the French, Belgian, and British armies in France and Flanders during the European War. He was knighted in 1920, and in 1921 was appointed editor of the *Review of Reviews*. His numerous novels and historical works include: *The Individualist*, *The Street of Adventure*, *The Romance of Empire*, *Men and Women of the French Revolution*, *King's Favourite*, *The Soul of the War*, *Open Warfare*, *The Way to Victory*, and *Realities of War*.

Gibel (jib'el), a fish of the carp family, *Carassius gibelio*, generally known in England as the

Prussian carp, and distinguished from the common carp (*Cyprinus carpio*) by having no barbules at the mouth. Probably only an elongated variety of the Crucian carp (*Carassius vulgaris*). It is a good table fish, but seldom weighs more than $\frac{1}{2}$ lb. It is said to be able to live thirty hours out of water.

Gibeon, one of the ancient royal cities of the Canaanites, a 'great city' of the Hivites, who at an early stage of Joshua's conquests, by disguising themselves in old clothes and professing to come from a far country, obtained an alliance and covenant with the Israelites. When the stratagem was discovered, the Israelites resolved to observe the covenant, but condemned them to be "hewers of wood and drawers of water unto all the congregation" (*Jos. ix, 21*). It was during the battle there between Joshua and the five kings of the Amorites that the sun stood still upon Gibeon, and the moon in the valley of Ajalon. Gibeon has been identified with the modern El-Jib.

Gibraltar (jib-ral'tar), a town and strongly-fortified rocky peninsula near the southern extremity of Spain, constituting a British Crown Colony. It is connected with the mainland by a low sandy isthmus, $1\frac{1}{2}$ miles long and $\frac{1}{2}$ mile broad, known as the 'neutral ground', and has Gibraltar Bay on the west, the open sea on the east and south. The highest point of the rock is about 1400 feet above sea-level; its north face is almost perpendicular, while its east side exhibits tremendous precipices. On its south side it is almost inaccessible, making approach from seaward impossible; the west side, again, although very rugged and precipitous, slopes towards the sea; and here the rock is secured by extensive and powerful batteries, rendering it apparently impregnable. Vast sums of money and an immense amount of labour have been spent in fortifying this celebrated stronghold, which, as a coaling-station, depot for war material, and a port of refuge in case of war, forms one of the most important points of support for British naval operations and British commerce eastwards. Numerous caverns and galleries, extending 2 to 3 miles in length, and of sufficient width for carriages, have been cut in the solid rock, with port-holes at intervals of every 12 yards bearing upon the neutral ground and the bay, and mounted with more than 1000 guns, some of them of the largest size. The garrison numbers about 5000. The town of Gibraltar is situated on the west side of the peninsula, terminating in Europa Point, and thus fronts the bay. It consists chiefly of one spacious street about $\frac{1}{2}$ mile in length, lined with shops, and paved and lighted. The principal buildings are the Governor's and Lieutenant-Governor's houses, the admiralty, naval hospital, victualling office, and

barracks, and a handsome theatre. Its water-supply is derived from the rainfall. Gibraltar is a free port, but there is a duty on malt liquors, wine, spirits, and tobacco. It has a considerable shipping trade, being an entrepôt for the distribution of British manufactures. The chief export is wine. The administration is vested in the Governor, who is also commander-in-chief of the troops. There is a harbour of 260 acres. In 1920 the civil population amounted to about 17,773, 1733 of them being aliens. The colony is self-supporting, its revenue and expenditure in 1919 amounting to £239,397 and £136,432 respectively. Gibraltar, known to the Greeks as Calpe, was first fortified as a strategic point by the Saracen leader Tarik Ibn Zeiad in 711-12, from whom it was thenceforward called Gebel-al-Tarik, the rock of Tarik. It was ultimately taken by the Spaniards from the Moors in 1462, fortified in the European style, and so much strengthened that the engineers of the seventeenth century considered it impregnable. It was taken, however, after a vigorous bombardment in 1704 by a combined English and Dutch force under Sir George Rooke and Prince George of Darmstadt, and was secured to Britain by the Peace of Utrecht in 1713. Since then it has remained in British hands, notwithstanding some desperate efforts on the part of Spain and France to retake it. During 1704-5 it was closely besieged; in 1727 it was hard pressed by a Spanish force when Admiral Wager, with eleven ships of the line, relieved it. In 1779, Britain being then engaged in a war with its revolted colonies and with France, a last grand effort was made by Spain to recover Gibraltar. The siege lasted for nearly four years, the fire being for the great part of that time very harassing, and rising on several occasions into a fierce and prolonged bombardment. It was heroically and successfully defended, however, by General Elliot (afterwards Lord Heathfield) and the garrison. Since that time, in the various British and Spanish, and also French wars, Gibraltar has only been blockaded on the land side.—BIBLIOGRAPHY: J. H. Mann, *Gibraltar and its Sieges*; Boyle, *Gibraltar* (British Empire Series); G. J. Gilbard, *Popular History of Gibraltar*; A. Macmillan, *Malta and Gibraltar*.

Gibraltar, Straits of, the channel which forms an entrance from the Atlantic into the Mediterranean. The narrowest part is a little to the west of Gibraltar, and 8½ miles across. A strong and constant current flows into the Mediterranean from the Atlantic Ocean, in the middle of the Straits, but the undercurrent as well as two feeble lateral currents along the coast set towards the ocean.

Gibson, John, one of the most distinguished English sculptors of modern times, born near

Conway, in Wales, in 1790, died at Rome in 1866. He was the son of a landscape-gardener, and was apprenticed to a wood-carver at Liverpool, and then to the proprietor of a marble-works, where he attracted attention by a figure of *Time*, modelled in wax, which he exhibited at the age of eighteen. The patronage of William Roscoe, the historian, assisted him to go to Rome, where he was cordially received by Canova. On the death of Canova in 1822 Gibson entered the studio of Thorwaldsen. His reputation was now widely spread, and his works were eagerly sought after by his countrymen. In 1836 he was made a Royal Academician; but to the end of his life he continued to make Rome his chief place of residence. Most of Gibson's subjects are taken from classical mythology, and are executed with a noble severity and purity of style based upon close observation of nature. Amongst his best works are: *The Wounded Amazon*, *The Hunter and his Dog*, *Hylas surprised by Nymphs* (in the National Gallery), *Heleen*, *Proserpine*, *Sappho*. He also executed portrait-statues; and in the bas-relief found a particularly congenial mode of expression. One of his peculiarities as an artist was the practice of colouring his statues.

Gibson, Margaret Dunlop, née Smith, British Orientalist, born at Irvine, in Ayrshire, died 11th Jan., 1920. Educated privately, she visited Palestine several times, and in 1892 she and her sister, Mrs. Agnes Lewis, discovered and photographed the famous Syriac palimpsest of the Gospel. In 1897 she and her sister laid the foundation stone of Westminster Theological College, Cambridge, the site of which they had given. In 1915 she received the gold medal from the Royal Asiatic Society. Her works include: *How the Codex was Found* (1893), *Apocrypha Sinaitica* (1896), *Commentaries on Acts* (1913), and *Commentaries on St. Paul's Epistles* (1916).

Gideon (Heb., meaning a destroyer), the son of Joash, of the tribe of Manasssch, divinely called to deliver the Israelites from the oppression of the Midianites. Having effected their deliverance, he was chosen judge of Israel. (See *Judges*, vi-viii.)

Giers (gēr), Nicholas Carlovitch de, a Russian statesman descended from a Swedish family settled in Finland, was born in 1820, and died in 1895. After holding various posts, in 1875 he became assistant to Prince Gortschakov, the Minister of Foreign Affairs, whom he succeeded in 1882. His policy in general was of a peaceful tendency, and in particular opposed to Pan-slavistic ideas of development. In Central Asia, however, he continued the policy of advance, and in 1885 the Russian occupation of positions within the Afghan frontier nearly brought about a war with Britain.

Giessen (gē'sen), a town of Germany, capital

of the province of Upper Hesse (Oberhessen), in the former Grand-Duchy of Hesse, on the Lahn. It was once fortified, and is still entered by four gates, but its ramparts have been converted into pleasant walks. It has a castle, now converted into Government offices, and a university founded in 1607, and possessing valuable apparatus, an observatory, and a botanical garden. Pop. 33,409.

Giffen (gif'en), Sir Robert, British statistician and financial writer, born in Lanarkshire in 1837, died in 1910. After being in a solicitor's office, and studying at Glasgow University, he entered a Glasgow commercial house, and next became connected with the press, being successively on the staffs of *The Globe*, *Fortnightly Review*, *Economist*, and *The Daily News*. In 1876 he was appointed chief of the Statistical Department of the Board of Trade. In subsequent extensions of the branch he became assistant-secretary to the Commercial Department (1886-92), and Controller-General of the Commercial, Labour, and Statistical Departments, retiring in 1897. He wrote numerous reports on financial matters, and gave evidence before many parliamentary committees and royal commissions. He became F.R.S. in 1892 and K.C.B. in 1895, and was a member of the Royal Commission on Agriculture, 1894-7. His publications include: *Stock Exchange Securities* (1878), *Essays on Finance* (1879 and 1886), *Trade Depression and Low Prices* (1885), *The Growth of Capital* (1890), *The Case against Bimetallism* (1892), and *Economic Enquiries and Studies* (1904).

Gifford, William, a critic and satirist, born at Ashburton, in Devonshire, in 1757, died in 1826. He was apprenticed to a shoemaker, but possessing a strong taste for study, he was enabled by the kindness of some friends to go to school and afterwards to Oxford University. After being some time tutor in Earl Grosvenor's family he published in 1794 *The Baviad*, a satire directed against the poetasters of the Della Crusca school; and in 1795 *The Mæviad*, a severe satire on the contemporary drama. In 1797 he became editor of the *Anti-Jacobin*; and he published a translation of Juvenal in 1802. On the foundation of the *Quarterly Review* in 1809 he became its editor, conducting it with much ability. He also edited the works of Massinger, Ford, Jonson, and Shirley. He was interred in Westminster Abbey.

Gifford Lectures, lectureships endowed by Lord Gifford, one of the judges of the Court of Session, Edinburgh, from 1870 to 1881, who left £80,000 for the purpose. They were founded in connection with the Universities of St. Andrews, Glasgow, Aberdeen, and Edinburgh, and are for the exposition of natural religion in the widest sense of that term: the lecturers to be subjected to no test of any kind; to belong to any denomi-

nation whatever, or to no denomination. The appointments are for two years, but may be held for six. The lecturers are to deliver a yearly course of about twenty original lectures open to all. The first lecturers were: Max Müller, Hutchison Stirling, Andrew Lang, and E. B. Tylor.

Gijón (hē-hōn'), a seaport in Spain, on the Bay of Biscay. It consists of an old and a new town, the former on the upper part of a slope and the latter below. It contains a cigar manufactory, employing about 1400 persons, and has various other industries and a good trade. Pop. 55,248.

Gila (jē'lá), Rio, a North American river, which rises in New Mexico and flows westward for 450 miles, and then unites with the Colorado. Curious ruins of stone-built houses occur all along its banks. In these are found fragments of pottery.

Gilbert, Sir Humphrey, English navigator of the reign of Queen Elizabeth, born in Devonshire about 1539. In 1578 he obtained from the queen a patent, empowering him to discover and colonize in North America any land then unsettled, and made an unsuccessful voyage to Newfoundland. In 1583 he sailed to it again, and took possession of the harbour of St. John's. Shortly after he embarked in a small sloop to explore the coast, and was lost in a storm.

Gilbert, Sir John, R.A., English painter, born in 1817, died in 1897. The first picture he exhibited (in 1836) was *The Arrest of Lord Hastings*, in water-colour, which medium he used constantly all his life. He also painted in oil, and among his more notable productions therein are, *Don Quixote giving Advice to Sancho Panza*, *The Education of Gil Blas*, and a series of tableaux of the principal characters in Shakespeare. He was particularly successful in depicting scenes from old English life, and won a great reputation as an illustrator of books and periodicals, being a regular contributor to *Punch* and *The Illustrated London News*. In 1871 he became president of the Royal Society of Water-Colour Painters. In the same year he was knighted, and in 1872 he became an A.R.A., becoming R.A. in 1876. In 1893 he presented a large collection of his pictures to various art galleries, including the Guildhall Gallery, London, and received the freedom of the city.

Gilbert, Sir William Schwenck, English dramatist, was born on 18th Nov., 1836, and died on 28th May, 1911. His father was William Gilbert (1804-90), who was an assistant surgeon in the navy, and a novelist of some note, his best-known books being *Shirley Hall Asylum* (1863), *Doctor Austin's Guests* (1866), and *The Wizard of the Mountain* (1867). Gilbert was educated at Boulogne, at the Western Grammar School, Brompton, and at the Great Ealing

School. He entered King's College, London, in Oct., 1855, and graduated B.A. at London University in 1857. In 1855, when the Crimean War was at its height, he entertained the idea of competing for a commission in the Royal Artillery, but the declaration of peace put an end to this project. Gilbert, however, was interested in soldiering, and obtained a commission in the militia in the 3rd Battalion Gordon Highlanders in 1857, becoming a captain in 1867, and retiring with the rank of major in 1883. His military knowledge proved of some value to him subsequently when drilling the choruses of his operas.

In 1857 Gilbert entered the education department of the Privy Council office, where he spent four unhappy years. In 1861 a small legacy enabled him to leave this uncongenial work and read for the Bar. He was called in Nov., 1863, and joined the northern circuit, but only earned £75 in two years. Meanwhile he was supporting himself by means of journalism, writing for *Fun*, a comic paper then edited by H. J. Byron. To this paper he contributed the famous series of comic poems known as *The Bab Ballads*. Gilbert was a talented illustrator, and drew admirable illustrations for these ballads, as well as for some of his father's novels.

Gilbert commenced his career as a dramatist in 1866 with a burlesque on *L'Elkair d'Amore* entitled *Dulcamara*, or *The Little Duck and the Great Quack*. This was followed by several other burlesques, including *La Vivandière* and *Robert the Devil*. He then tried his hand at more serious plays, and wrote *The Palace of Truth* (1870), *The Wicked World* (1873), and *Pygmalion and Galatea* (1871). The last-named was highly successful, and brought Gilbert in £40,000. Assisted by Gilbert à Beckett, Gilbert wrote a burlesque on his own play *The Wicked World*. This burlesque was entitled *The Happy Land* (1873), and caused much sensation because three of the actors were made up to resemble Gladstone, Lowe, and Ayrton, members of the Government at that time. This feature of the performance was suppressed by order of the Lord Chamberlain. *Charity*, a serious play, was produced in 1874, and enjoyed only a moderate success. *Sweethearts*, a pleasantly sentimental dramatic contrast, appeared in the same year. *Dan'l Druce*, a serious play founded upon the story of *Silas Marner*, was produced in 1876, and *Engaged*, a cynical farce based upon the Scottish marriage laws, in 1877.

In 1871 Gilbert was introduced to Sullivan, and the immediate result was a comic opera, *Thespis*, or *The Gods Grown Old*. In 1875 they collaborated in *Trial by Jury*, a dramatic cantata of exquisite finish, satirizing the procedure in a breach-of-promise case. The great series of

operas, however, may be said to have begun with *The Sorcerer* in 1877. The others are: *H.M.S. Pinafore*, or *The Lass that Loved a Sailor* (1878); *The Pirates of Penzance*, or *The Slave of Duty* (1880); *Patience*, or *Bunthorne's Bride* (1881); *Iolanthe*, or *The Peer and the Peri* (1882); *Princess Ida*, or *Castle Adamant* (1884); *The Mikado*, or *The Town of Titipu* (1885); *Ruddigore*, or *The Witch's Curse* (1887); *The Yeomen of the Guard*, or *The Merryman and His Maid* (1888); *The Gondoliers*, or *The King of Barataria* (1889); *Utopia Limited*, or *The Flowers of Progress* (1893); and *The Grand Duke*, or *The Statutory Duel* (1896). A more perfect partnership than that of Gilbert and Sullivan never existed, and the Savoy operas are unique in every way. Indeed, they may all be said to be virtually flawless, and none of them has strong claims to pre-eminence over the others. For dainty whimsicality *Iolanthe* is hard to beat, and for deft construction and urbane satire *Patience* is unsurpassed. Gilbert had a marvellous mastery over comic metre, and, in point of fact, invented many new metrical forms. His words set themselves to music. His plots, though fantastic, are always coherent, and a curious strain of inverted logic runs through all his work. The operas brought Gilbert fame and wealth. *The Mikado*, perhaps the most popular of the series, brought him in £30,000, and *Ruddigore*, one of the least successful, £7000.

Gilbert wrote one or two libretti for other composers. Alfred Cellier wrote the music of *The Mountebanks* (1892), and Dr. Osmond Carr that of *His Excellency* (1894). Edward German composed the score of *Fallen Fairies* (1909), an operatic version of *The Wicked World*. Gilbert's last play was a realistic sketch called *The Hooligan* (1911). He died in May, 1911, of heart failure while saving a lady from drowning in his swimming-lake. Gilbert was a J.P. and D.L. for Middlesex, and was knighted in 1907.

Gilbert had no predecessors in opera-writing; he invented his own methods and left no successor. He was a highly original genius, and left the mark of his originality on everything he wrote. He was a master of stage-craft, and thought no trouble too great to take to secure the effect he desired. Probably no dramatist ever had his own intentions so exactly carried out, as he was his own stage manager, and something of a martinet, at rehearsals. In all his work there is literary grace and finish, and a logical absurdity to which the epithet 'Gilbertian' is applied. His works are full of quotations which have become part of the language, and are also full of sound common sense. Great as is the difference, in some ways, between

the Athenian comic poet and the Victorian dramatist, in literary deftness, in whimsicality, and in lyric grace and excellence Gilbert stands nearer to Aristophanes than any other English author.—BIBLIOGRAPHY: E. A. Browne, *W. S. Gilbert*; P. Fitzgerald, *The Savoy Opera and the Savoyards*; W. Archer, *English Dramatists of To-day*.

Gilbertines, an order of monks founded in England by Gilbert of Sempringham in the twelfth century. They followed the Augustinian rule, and their numerous monasteries were suppressed by Henry VIII. There were also Gilbertine nuns.

Gilbert Islands, or **Kingsmill Group**, a group of sixteen islands in the Pacific Ocean, on the equator, between long. 172° 0' and 177° 0' east, annexed by Britain 10th Nov., 1915; area, 166 sq. miles. They are of coral formation, low and not fertile. Their chief products are the coconut, pandanus, taro, and the bread-fruit tree. The Gilbert and Ellice groups, with Ocean Island, Fanning and Washington Islands, Christmas Island, and the Union (Tokelau) group, now form the *Gilbert and Ellice Islands Colony*. Pop. 26,417.

Gilbo'a (Heb., 'Bubbling Fountain'), a range of hills in Palestine, bounding the Plain of Esdraëlon on the north-east. One of them is identified with the ancient Gilboa, the scene of Saul's last fatal battle.

Gildas (gil'das) *the Wise* (*Sapiens*), a British ecclesiastic and historian of the sixth century, of whom little is known. There is extant a Latin treatise or diatribe ascribed to Gildas which bears the title of *Epistola de Excidio Britannie* (on the Destruction of Britain), but the violent invective which it employs against the Britons has led to doubts respecting its authenticity.

Gilding is the art of applying gold-leaf or gold in a finely-divided state to surfaces of wood, stone, or metals, an ancient art which was practised among the Egyptians, Greeks, Romans, and Ancient Persians. The processes employed at the present day are very varied. Metals are gilded either by what is called chemical gilding, mercurial gilding, by electro-gilding, or by the application of gold-leaf. Copper and brass, for instance, may be gilded by the process called *wash* or *water gilding*, with an amalgam of gold and mercury. The surface of the copper, freed from oxide, is covered with the amalgam, and afterwards exposed to heat till the mercury is driven off, leaving a thin coat of gold. Iron or steel is often gilded by applying gold-leaf, after the surface has been well cleaned, and heated until it has acquired the blue colour which at a certain temperature it assumes. Several leaves of gold are thus applied in succession, and the last is burnished down cold. In one process of chemical gilding the article is dipped into a

solution of gold, what is termed Elkington's solution being composed as follows: 5 oz. (troy) of fine gold; nitro-muriatic acid, 52 oz. (avoirdupois); dissolve by heat, and continue the heat until the cessation of red or yellow vapours; decant the clear liquid; add 4 gall. of distilled water, pure potassium bicarbonate 20 lb., and boil for two hours. Gilding on wood, plaster, leather, parchment, or paper, is performed by different processes of mechanical gilding. The first of these is oil-gilding, in which gold-leaf is cemented to the work by means of oil-size. In the case of paper or vellum the parts to be gilt receive a coat of gum-water or fine size, and the gold-leaf is applied before the parts are dry. They are afterwards burnished with agate. Lettering and other gilding on bound books is applied without size. The gold-leaf is laid on the leather and imprinted with hot brass types. Brass rollers with thin edges are employed in the same way for lines, and similar tools for other ornaments. When the edges of the leaves of books are to be gilt, they are first cut smooth in the press, after which a solution of isinglass in spirits is laid on, and the gold-leaf is applied when the edges are in a proper state of dryness. Japanner's gilding is another kind of mechanical gilding, which is performed in the same way as oil-gilding, except that instead of gold-leaf a gold-dust or powder is employed. Frames of pictures and mirrors, mouldings, &c., are gilt by the application of gold-leaf, or by the cheaper process of 'German gilding', that is, by tin-foil or silver-leaf, with a yellow varnish above. Porcelain and other kinds of earthenware, as well as glass, may be gilt by fixing a layer of gold in a powdered state by the action of fire. The gold-dust or powder required in this operation may be obtained by precipitating it from a solution in aqua regia, by means of either sulphate of iron or proto-nitrate of mercury. In order that the gold-powder may be applied to the surface of the article to be gilt it must be well mixed with some viscous vehicle, such as strongly-gummed water. It is then laid on with a fine camel's-hair brush.—Cf. F. Scott Mitchell, *Practical Gilding*.

Gil'ead, a mountain region of Palestine, east of the Jordan, having Bashan on the north and Moab and Ammon on the south. It was noted for its balm, as well as for its pasturage.

Giles (jilz), St. (*St. Ægidius*), a native of Greece, who, according to the legend, lived in the sixth century, and was descended from an illustrious family. He is said to have worked miracles, and founded a convent in France. He became patron saint of Edinburgh, and his festival falls on the 1st of September.

Gilfil'an, George, writer, born in 1813, died in 1878. He studied at Glasgow University, in

1835 he became a licentiate of the Secession (Presbyterian) Church, and in 1836 was ordained to the School Wynd Church, Dundee. His numerous writings, among which may be mentioned *A Gallery of Literary Portraits*, *The Bards of the Bible*, and *The Martyrs of the Covenant*, possess a vigorous style and great powers of fancy.

Gilghit, or **Gilgit** (gil'git), a valley and district in Kashmir state, situated on the southern slopes of the Hindu Kúsh, and watered by the Gilgit, or Yasm, a tributary of the Indus.

Gill (gil), Sir David, astronomer, born in Aberdeenshire in 1843, died in 1914. He was educated at Aberdeen University, where he erected a private observatory for himself in 1868, and was associated with Lord Lindsay (Earl of Crawford) in the building of another at that nobleman's seat of Dunecht (Aberdeenshire), of which he was in charge from 1872 to 1876. He organized Lord Lindsay's Transit of Venus expedition to Mauritius in 1874, and subsequently measured the base line for the Geodetic Survey of Egypt. In 1877 he organized an expedition to the Island of Ascension to determine the solar parallax by observations of Mars, publishing an account in the *Memoirs of the Royal Astronomical Society*. In 1879 he was appointed Astronomer Royal at the Cape of Good Hope, a post which he held till 1907. While holding this post he organized Transit of Venus expeditions, proved the value of photography for the complete cataloguing of stars, agitated for and set on foot the Geodetic Survey of South Africa, and directed the Boundary Survey between British Bechuanaland and German territory. He was created a K.C.N. in 1900, and received many other distinctions in recognition of his services to science. His numerous publications include works on *Heliometer Determinations of Solar and Stellar Parallax*; *the Cape Photographic Durchmusterung*; and *History and Description of the Royal Observatory, Cape of Good Hope*.

Gillies (gil'iz), John, Scottish historian and scholar, born at Brechin in 1747, died at Clapham in 1836. He was educated at the University of Glasgow, and finally settled in London, where he applied himself to literature. He published *The Orations of Lysias and Isocrates, translated from the Greek*; *History of Ancient Greece*; a translation of Aristotle's *Ethics and Politics*, with other works upon Aristotle; and *A View of the Reign of Frederick II of Prussia*.

Gillingham, a municipal borough of Kent, north-east of Chatham, on the Medway, which is navigable there. It has an interesting church, with Norman font and fine fifteenth-century brasses, and there are some remains of a palace which used to belong to the Archbishops of Canterbury. A quantity of fruit is grown in the

neighbourhood. Edmund Ironside is said to have conquered the Danes close by. Pop. 54,038.

Gillray, James, an English caricaturist, born in 1757, died in London in 1815. He studied at the Royal Academy schools, and some clever sketches, such as *Paddy on Horseback*, published about 1780, first attracted attention to him. From this time till about 1810 he achieved a European reputation by a succession of caricatures, numbering about 1200 and marked by great technical mastery, in which the king (George III) and the members of the House of Lords, and afterwards the French and the French celebrities of the day, were the chief objects of ridicule. In his closing years he was attacked by a mental malady, largely due to intemperance, which continued till his death.

Gills, the respiratory organs of animals which breathe by absorbing dissolved oxygen from water, as crustaceans, some insect larvæ, most aquatic molluscs, fishes, and amphibians. In fishes they consist of highly vascular folds or filaments, attached to cartilaginous or bony arches in the walls of the perforated pharynx. Water is taken in at the mouth and expelled through the gill-slits to the exterior, bathing the gills as it does so.

Gillyflower (jil'i), a name bestowed on such cruciferous flowers as the wall-flower or carnation, &c. The clove-pink (*Dianthus Caryophyllus*) is termed clove gillyflower.

Gilo'lo, or **Jilolo**, an island in the Indian Archipelago, the largest of the Moluccas; area, 6950 sq. miles. It is of singular form, consisting of four peninsulas, radiating north, north-east, east-south-east, and south, from a common centre, and having large bays between. It is rugged and mountainous, the mountains being volcanic. The principal productions are sago, coco-nuts, spices, fruits, edible birds'-nests, and timber; horses, cattle, and sheep abound. Deer, wild boars, and other game are likewise plentiful. The original inhabitants, called Alfuros, have been gradually pressed into the interior by the Malays. The island, included in the Residency of Ternate, belongs to the Netherlands; pop. about 120,000.

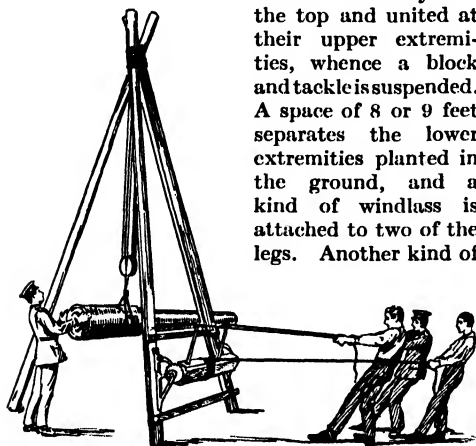
Gilthead (*Chrysophrys auratus*), a spiny-finned fish of the Sparidæ or sea-bream family common in the Mediterranean. It has strong grinding teeth for crushing the shells of the molluscs on which it feeds; a crescentic yellow band stretches from eye to eye (whence its generic name, signifying 'golden eye-brows'). Its colour is a mixture of silver and sky-blue, its dorsal and caudal fins are black, while brown lines pass along the sides. It sometimes reaches a weight of 18 to 20 lb. Giltheads were among the fishes fattened for the table by the ancient Romans.

Gimbals (jim'balz; O.Fr. *gemeau*; Lat. *gemel-*

lus, twin), the name of the pair of rings within which the mariner's compass is slung, or any pair of similar rings. The gimbals maintain the compass-bowl and the compass-card in a horizontal position, there being two concentric rings, the outer turning about a horizontal axis, and the inner turning about a similar axis at right angles to the other. Ship chronometers are often suspended the same way.

Gin, a spirit distilled from grain, and flavoured with juniper-berries, and sometimes with oil of turpentine and common salt, and other substances. The name is from *genièvre*, the French for 'juniper'. It is largely manufactured in Holland, particularly in Schiedam, and the gin thence imported is thus often called Schiedam as well as Hollands. In Great Britain gin is largely manufactured in London, where it often goes by the name of *Old Tom*, and to a less extent at Plymouth and Bristol. What is termed 'gin' in Great Britain differs materially from Hollands and even from the best English gin, as it is a plain corn spirit, which derives its flavour from oil of turpentine, with certain aromatics in small quantities.

Gin, the name of certain machines employed in raising weights. One form consists of three poles, 12 to 15 feet long, often tapering from the lower extremity to the top and united at their upper extremities, whence a block and tackle is suspended. A space of 8 or 9 feet separates the lower extremities planted in the ground, and a kind of windlass is attached to two of the legs. Another kind of

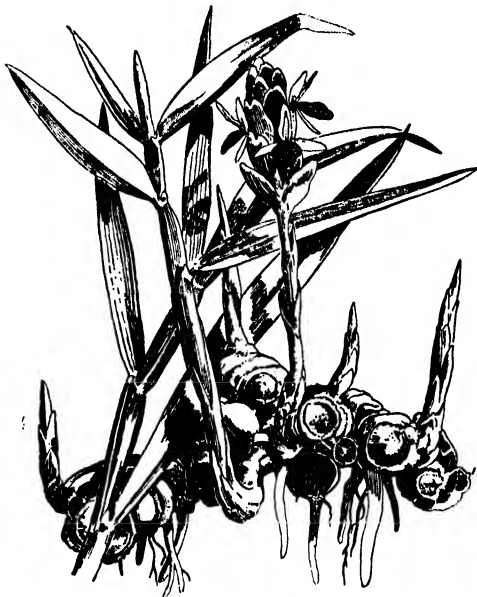


Gin

gin is a sort of whim or windlass for raising coal, &c. It is worked by a horse, which turns a cylinder, and winds on it a rope, by which the weight is raised.

Ginger (*Zingiber officinale*), an East Indian plant of the ord. Zingiberaceæ. It grows in moist places in various parts of tropical Asia and the Asiatic islands, and has been introduced into the West Indies, particularly Jamaica, as also into South America and West Africa. The

kind most esteemed is Jamaica ginger. The rhizome, or underground stem, is what is used, being employed in various ways. It has an aromatic, pungent taste, and when young is candied, and makes an excellent preserve. It is a favourite condiment, and is used medicinally as a carminative, and in debility of the stomach and the alimentary canal. It is often useful in cases

Ginger (*Zingiber officinale*)

Root, flower, and foliage.

of toothache, relaxation of the uvula, and paralytic affections of the tongue. It enters into the composition of a great number of confections, infusions, and pills. The special preparations are the *tincture* and the *essence* of ginger; and *syrup*, prepared by mixing twenty-five parts of syrup with one of the strong tincture. *Infusion* of ginger is a preparation useful for flatulence.

Ginger-beer, a pleasant, non-alcoholic, effervescing beverage, made by mixing together ginger, cream of tartar, sugar, yeast, and water, and allowing the whole to ferment for a time, then bottling. Ginger-beer may also be prepared thus: Add to each gallon of water 1 lb. of refined sugar, and $\frac{1}{2}$ oz. of ground ginger. Boil for an hour, add the white of two eggs, remove the scum. Strain into a vessel to cool, cask it up with the juice and peel of a lemon. Add a very small amount of brewer's yeast, and bung up tightly for a fortnight.

Gingham (ging'am), a cotton fabric distinguished from calico by having the colours woven

with the fabric, not printed on it. The patterns are various; sometimes fancy designs, sometimes chequered, and sometimes striped. Umbrella gingham are all of one colour.

Ginkgo, a genus of Gymnosperms, comprising the single species *Ginkgo biloba*, the maidenhair tree, the sole living type of the ancient class Ginkgoales. It is a handsome, hardy, deciduous tree, reaching 100 feet in height. The leaves resemble those of a maidenhair fern, but are much larger and coarser; other fern-like characters are the forked venation of the leaf and the presence of motile spermatozoids (found also in Cycads, but not in Conifers). The seed is edible and the timber useful. The tree is a native of China and Japan, where it is held sacred and grown in temple gardens. In Tertiary times this or allied species flourished in Britain.

Ginsburg (gins'burh), Christian David, rabbinical scholar, born in 1831, died in 1914. He is the author of *Commentaries on the Song of Songs* (1857), *Ecclesiastes*, and *Leviticus*; *The Karaites: their History and Literature*; *The Essenes*; *The Kabbalah: its Doctrines, Development, and Literature*, and other works of similar character. His greatest work is, however, the *Massorah*. He was one of the scholars engaged on the Revised Version of the Old Testament.

Ginseng (jin'seng), a plant of Northern Asia, *Panax ginseng*, ord. Araliaceæ, herbaceous, and about 1 foot high. Its root is regarded as a sort of panacea among the Chinese, and is largely imported, but it appears to be really of very little efficacy; the taste is sweet and mucilaginous, accompanied with some bitterness, and also slightly aromatic. Another species of ginseng, *Panax quinquefolium*, inhabits Canada and the north-eastern parts of the United States. Quantities of its root are sent to China.

Gioberti (jō-ber'tē), Vincenzo, an Italian philosopher and statesman, born at Turin 1801, died at Paris 1852. Having been educated for the Church, he was appointed chaplain to Charles Albert, King of Sardinia, but having lost favour owing to his republican sentiments, he was first imprisoned, and, in 1833, banished. The first few years of his exile he spent at Paris, and afterwards became a teacher of philosophy in a school at Brussels. There he published two works, one of which was an attempt to reconcile philosophy and Roman Catholicism. In 1843 appeared his *Primato Morale e Civile degli Italiani*, a defence on liberal principles of the Papacy, a work which brought over the majority of the priests to the national party. In 1847 he published a work entitled *Il Gesuita Moderno* (The Modern Jesuit). When Charles Albert in 1848 granted a constitution to Sardinia, Gioberti returned to his native country, but he soon after withdrew to Paris.

Gloja Del Colle (jō'yā del kol'lä), a town in Southern Italy, province of Bari, on a slope of the Apennines. Pop. (commune), 21,837.

Giolitti, Giovanni, Italian statesman, born at Mondovì, in the province of Cuneo, 1842. He was educated at the University of Turin, where he studied law, but soon turned his attention to politics and entered the Chamber of Deputies. Minister of Finance in 1889 in the Crispi Cabinet, and Premier and Minister of the Interior in 1892, he had to resign on account of bank scandals. He was again Prime Minister from 1903 to 1905, from 1906 to 1909, and from 1911 to 1914, when he was succeeded by Salandra. At the outbreak of the European War Giolitti was in favour of Italian neutrality. When the Nitti ministry fell in June, 1920, Giolitti again became Prime Minister.

Giordano (jor-dä'nō), Luca, Italian painter, born at Naples about 1632, died there 1705. He was called 'Fa Presto', his father having continually urged him on at his work with the words 'Luca, fa presto' (Luca, work quickly). He was a pupil of Ribera (Lo Spagnoletto), studied and copied the great Italian masters at Rome, and became the assistant of Peter of Cortona. Paul Veronese had afterwards great influence on his manner. After working in Naples and Florence, in 1692 he was employed by Charles II to decorate the Escorial, and at the court of Spain he became a great favourite. His work there shows the immense but mechanical facility for which he was famous. He could imitate older masters, notably Bassano, so well as to impose upon connoisseurs. But his eclecticism killed his originality. After the death of Charles II he was retained in the service of Philip V, but eventually returned to his native country. His best-known work are his frescoes in the Escorial, and paintings at Madrid, Florence, and Rome. Among his best work are: *Venus and Mars* in the Louvre, and *The Judgment of Paris* in Berlin.

Giorgione (jor-jō'nā), properly *Giorgio Barbarelli*, born in 1477 at Castelfranco, and died 1511. One of the most celebrated painters of the Venetian school, he more completely expresses the spirit of pagan poesy which marks the Early Renaissance than any other painter, and combines in his work classical harmony with a romantic and lyrical spirit. He was among the first to study the effect of light and atmosphere in modifying colour. Titian was closely associated with Giorgione, who influenced his early work. In Venice he ornamented the façades of several large buildings with frescoes, which have mostly perished. His portraits are among the finest of the Italian school. His works are rare, but good examples may be seen at Milan, Castelfranco, and in the galleries at Florence, Venice, Vienna, and Dresden. He is also repre-

sented in the National Gallery (*Golden Age*) and at Hampton Court (*Shepherd*).

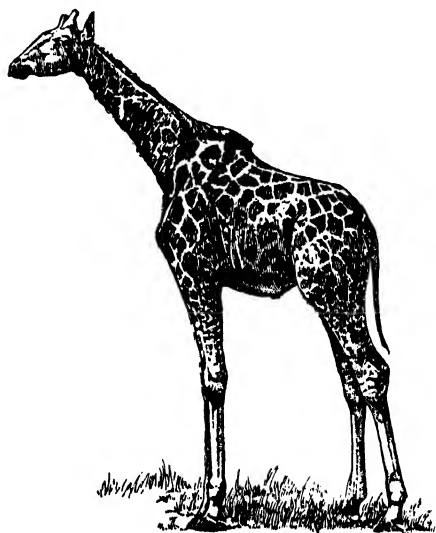
Giotta (jot'tō), properly *Ambrogio* or *Angiolotto Bondone*, a Florentine painter, born about 1266 at Vespignano, near Florence, died about 1337. In his boyhood he was a shepherd, and is said to have been seen by Cimabue, as he was drawing figures of his sheep upon a piece of slate, and to have been taken to Florence by that artist as a pupil. The strong naturalism which marks his work was a complete break with older traditions, and definitely changed the whole course of European painting. Joined to a sense of the dramatic, a feeling for form (developed by the study of sculpture) and a power of dignified and rhythmic design make him one of great figures of European art. Among his most important work are frescoes at Rome, at Assisi, in the Arena Chapel at Padua, and in S. Croce at Florence. Some panel pictures are also attributed to him. He was also a remarkable architect, the campanile of the cathedral of Florence being his work.—Cf. Crowe and Cavalcaselle, *History of Painting in Italy*.

Gippsland, the south-easternmost of the five districts into which the Australian colony or state of Victoria is divided; area, 13,898 sq. miles. Much of the north and east is covered by heavy timber, but the southern and western portions are fertile, and the mineral resources are enormous. The climate suits oranges, limes, hops, sugar-beet, tobacco, opium, &c. The mountain ranges rise to over 6000 feet.

Giraffe (ji-raf'), or Camelopard (Giraffa), a ruminant animal inhabiting Africa, and the type of a small family also including the Okapi (q.v.). It is the tallest of all animals, a full-grown male reaching the height of 18 or 20 feet. This great stature is mainly due to the extraordinary length of the neck, in which, however, there are but seven vertebrae, though these are extremely elongated. It has two bony excrescences on its head resembling horns, but permanently covered with skin. There is also a median prominence between the eyes commonly regarded as a third horn. Its great height is admirably adapted to its habit of feeding on the leaves of trees, and in this the animal is further aided by its tongue, which is both prehensile and capable of being remarkably elongated or retracted at will. When it browses on the herbage on the ground, it stretches out its fore-legs as widely as possible till it can reach the ground by means of its long neck. Its colour is usually light fawn, marked with darker spots. It is a mild and inoffensive animal, and in captivity is very gentle and playful. The giraffe is a native of a great part of Africa, from the latitude of Abyssinia southward to the Transvaal and the K'alahari Desert. There are two distinct species, one (*G. camelo-*

pardalis) native to Somaliland, and the other (*G. australis*) to South Africa. The third horn is much better developed in the latter.

Giral'dus Cambren'sis, an early English historian, born about 1146. His proper name was Gerald de Barry, and he was the son of William de Barry, a Norman noble of Pembrokeshire. He was educated under his uncle, the Bishop of St. David's, and afterwards at the University of Paris. He returned in 1172, and was appointed Archdeacon of St. David's. His uncle dying soon after, Gerald was elected to succeed him, but the king refused to confirm the appointment, and Gerald withdrew to Paris, where he was



Giraffe (*Giraffa australis*)

appointed professor of canon law. In the following year (1180) he returned to England, where he was required to administer the bishopric of St. David's, the proper bishop having proved himself incompetent. Giraldus discharged this office for four years, and was then appointed a royal chaplain. As companion to the king's son, Prince John, he went to Ireland in 1185, where he collected the materials for his *Topographia Hibernica*. He afterwards drew up a similar work on Wales (*Itinerarium Cambriae*). After the departure of Richard Cœur de Lion for Palestine, Gerald remained to conduct the affairs of the Government, but in 1192 retired to Lincoln for purposes of study. He was again elected to the see of St. David's, but Richard prevented his installation. He now retired from the world, and refused the bishopric when again offered to him. The year of his death is unknown. He was a man of great vanity and ambition,

and was also remarkable for his credulity. The *De Rebus a se Gestis*, which, with others of his minor works, is published in Wharton's *Anglia Sacra*, contains the most remarkable instances of the author's vanity and self-esteem.—Cf. H. Owen, *Gerald the Welshman*.

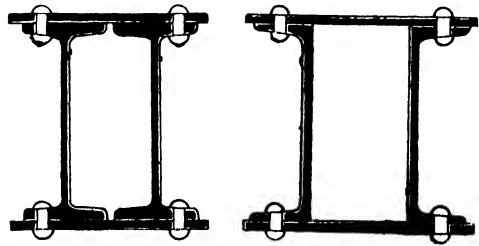
Girardin (zhê-râr-dan), Émile de, French journalist and politician, born in Switzerland in 1802, died in 1881. Educated in Paris, he was connected as projector, editor, or otherwise with a number of newspapers and periodicals, the most successful being *La Presse*, a Conservative organ established in 1836. A controversy in its columns led to a duel between Girardin and Armand Carrel, in which the latter was killed. In politics Girardin played many parts. He was fined 5000 francs in 1867 for attacks on the imperial Government in *La Liberté*. He wrote numerous political pamphlets, and a few pieces for the stage.—His first wife, Delphine Gay, daughter of the novelist Madame Sophie Gay, was a well-known authoress; born 1804, died 1855. She wrote the novels: *Émile*, *Le Lorgnon*, *Le Marquis de Pontanges*, *La Canne de M. de Balzac*, *Il ne faut pas jouer avec la douleur*, and *Marquerite*; contributed to the *Presse* newspaper, and wrote for the stage *Lady Tartuffe*, *La Joie fait peur*, *Le Supplice d'une femme*, and other pieces.

Girasol (jî'ra-sôl), a precious opaline stone, which, under strong lights, reflects a brilliant reddish light. It is usually of a milk-white or bluish-white colour. The brightest are brought from Brazil and Siberia. The name is sometimes bestowed on the *Asteria sapphire*. One variety is known as the fire opal.

Girder, in structural engineering, a beam. The term 'girder' is usually reserved for a beam of iron or steel. A girder is designed to resist bending. The cross-section of the girder is, therefore, shaped so as to secure the maximum

minimum if the least amount of material is to be used. The best compromise is, therefore, to put as much of the area as possible at the maximum distance from the centre of the section. Hence the I girder, consisting of a top and bottom flange, with a thin web connecting them, has come into being. The bulk of the area of the cross-section is the area of the flanges which are at the maximum distance from the centre of the cross-section. The formula for the working stress in a nearly straight girder is $p = \frac{My}{I}$,

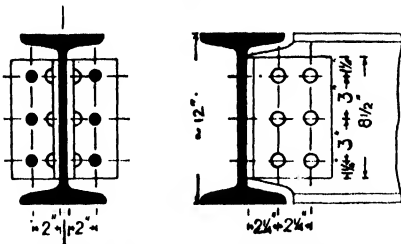
where p is the fibre stress on the outside layers of the flange in pounds per square inch, M is the bending-moment in pound inches, y is half the depth of the girder in inches, and I is the moment of inertia of the cross-section in inch



Compound Girders

units (in.⁴), assuming the cross-section to be of unit density.

Girders may be supported at both ends, or they may be built into a wall at one end and unsupported at the other, when they are called *cantilevers*. Sometimes a very long girder is supported by three or four iron pillars. Such a girder is called a *continuous beam*. In very large girders, such as those used for railway bridges, the shape of the girder is roughly the same as the bending-moment diagram. For instance, the bending-moment of a beam, supported at each end, is greatest at the middle of the span and least at the supports themselves, and a glance at any well-designed railway girder will show that its depth is greatest at the middle and least at the supports. Continuous girders are apt to be dangerous, because the intermediate supports may sink a little and so entirely alter the distribution of the load. In a design like the Forth Bridge each column supports its own load independently, and the intermediate connecting links between the columns are hinged and hung so that any slight movement in the foundations of any one of the columns would not materially alter the distribution of the loading.—BIBLIOGRAPHY: A. Morley, *Strength of Materials*; W. H. Warren, *Engineering Construction in Iron, Steel, and Timber*.



Sections of Main and Cross Girders, showing Connections

resistance to bending with the minimum weight of metal. For a given working stress and depth of girder, the maximum resistance to bending is obtained when the moment of inertia of the cross-section about an axis parallel to the axis of the bending-moment is greatest. On the other hand, the area of the cross-section must be a

Girdle of Venus (*Cestum Veneris*), an animal belonging to the Ctenophora, found in the Mediterranean and Atlantic. In shape it resembles a ribbon, and may exceed a yard in length. It swims by gracefully undulating its body. It is iridescent by day, and brilliantly phosphorescent at night. Related species are found in the White Sea and Indian Ocean.

Girgeh (jir'je), a town, formerly capital, of Upper Egypt, on the left bank of the Nile. It possesses a Roman Catholic convent, the oldest in Egypt. Pop. 19,893.

Girgenti (jir-jen'tē), a town in the south-west of Sicily, capital of the province of same name, 58 miles S.S.E. of Palermo, a few miles from the sea, on an elevated site, with a cathedral (dating from the fifteenth century), library (founded in 1765), and museum. It exports wheat, oil, fruit, and sulphur, its port being Porto Empedocle. Near the town are the extensive and remarkable ruins of the ancient Agrigentum. Pop. 27,106.—The province has an area of 1175 sq. miles, and is rather mountainous. Pop. (1915), 409,133.

Girl Guides, The (Incorporated), is the sister movement to that of the Boy Scouts, and was founded by Sir Robert Baden-Powell shortly after the inception of his Boy Scout movement in 1908. The organization is identical in principle with that of the Boy Scouts, its aim being to inculcate upon girls of every class self-development in the attributes of Character and Intelligence, Physical Health through Self-knowledge, Service for the Community, and Handicrafts. Instruction is given in each of these four points by means of interesting games and hobbies, all encouraging friendly rivalry by means of inter-patrol competitions. Proficiency badges are awarded to those who pass certain tests in such subjects as Ambulance, Child Nursing, Cookery, Dressmaking, Gardening, Housekeeping, Knitting, Laundry, Needlework, Sick Nursing, &c., all admirable womanly accomplishments which cannot fail to have a beneficial influence on the character of the girls. The Guide Promise and Law, on which the whole training is founded, corresponds with those of the Scout movement. See *Boy Scouts*.

Girodet-Trioson (zhē-ro-dā-trē-o-sōn), Anne Louis Girodet de Roussy, French historical painter, born in 1767, died 1824. A pupil and follower of Louis David, in 1810 he won the 'grand prix' (for his *Scene from the Deluge*) over his master's head. Like David he is a draughtsman rather than a colourist. Among his famous pictures are: *Endymion*, *Hippocrates*, *The Deluge*, *The Burial of Atala*, *Napoleon receiving the Keys of Vienna*, and *St. Louis in Egypt*.

Gironde (zhē-rōnd), a department of France, on the Bay of Biscay, named from the Gironde

estuary; area, 4140 sq. miles. The surface is generally flat, and almost the whole department belongs to the basin of the Gironde, which is formed by the junction of the Dordogne and Garonne. The climate is generally mild and extremely moist. One-third of the surface is waste, and about one-fourth is arable land. The staple production is wine, Médoc, Graves, Côtes, and Entre-deux-Mers being the most celebrated growths. (See *Bordeaux Wines*.) The forests of oak and pine are extensive. The minerals are unimportant, but much salt is obtained from lagoons. The manufactures are varied; the trade, which has its centre at Bordeaux, is very important. Bordeaux is the capital. Pop. 819,904.

Girondists (*Girondins*), one of the great political parties of the first French revolution. The Girondists were Republicans, but were more distinguished for visionary ideals than for a well-defined policy; hence they fell an easy prey to the party of the Mountain. Their leaders were three of the Deputies of the Gironde—Vergniaud, Guadet, and Gensonné—hence the name. Louis XVI was obliged, in 1792, to select a ministry from among the Girondists, but it was short-lived. In the Convention their struggles with the Montagnards forced them into extreme measures which they would otherwise have avoided. They wished to save the king, but many of them, from a mistaken policy, voted for his death. Their fall dates from their unsuccessful impeachment of Marat (1793), soon after which a large number of them were proscribed, and twenty-one of them were condemned and executed.—Cf. Mignet, *The French Revolution*.

Girtin, Thomas, English water-colour painter, born in Southwark in 1775, and died in 1802. He early made the acquaintance of Turner, and the two often went sketching together. He first exhibited at the Royal Academy in 1794, a water-colour drawing of Ely Cathedral; and he followed this up in subsequent years by showing, chiefly, architectural subjects, whose romantic treatment marks an important development from the work of earlier topographical draughtsmen. His only oil-painting, *Bolton Bridge*, was hung in 1801, and a breakdown in health prevented further work. Girtin was one of the first to use water-colour with the same power and freedom as oil-paint. Despite his early death, he has exercised great influence. He is well represented in the British Museum and in the Victoria and Albert Museum.

Girton College. The institution now known as Girton College was founded in 1869 by a committee of eminent men and women, including Sir John Gorst, Miss Emily Davis, the Dowager Lady Stanley of Alderley, and Mr. Sedley Taylor. The college had its first home in a small house

at Hitchin; but before long the distance between Hitchin and Cambridge became an inconvenience, and in 1872 the present building was opened at Gorton village, near Cambridge. Between 1872 and 1881 the students read for the Tripos examinations of Cambridge University, but the examiners retained the option of refusing to mark their papers. In 1881, however, the Senate reconsidered the whole matter of the women's colleges (Newnham College had by now been founded), and decided by a large majority formally to admit women to the Tripos examinations on an equal footing with men, and to grant them certificates. Cambridge University was the first English university to grant these privileges to women. From the first the students of Gorton have been required to pass an entrance examination; and at the present day (1921), owing to the large number of applicants for admission, this has been replaced by the scholarship examination in the subject the candidate intends to read at college. The students generally read for the Honours examinations of the university—occasionally for the degree of Bachelor of Music.

Girvan (gir'van), a seaport of Scotland, county of Ayr, situated at the head of a fine bay, on the Girvan. The winter herring fishery is the most important industry. Pop. 7272.

Gisborne, a town in New Zealand (North Island), capital of the Poverty Bay district and of Cook County, 85 miles north-east of Napier, on the Rivers Turanganui and Taraheru. It is the centre of a fine pastoral and agricultural district, which exports wool, frozen mutton, maize, and dairy produce. Petroleum has been discovered there, and there are hot springs in the neighbourhood. It was near the site of Gisborne that Captain Cook landed in 1769. Pop. 14,366.

Gisors (zhē-sōr), a town of Northern France, department of Eure, with a well-preserved castle of the twelfth century. Pop. 5508.

Gissing, George Robert, British novelist, born at Wakefield, 22nd Nov., 1857, died in the Pyrenees, 28th Dec., 1903. Educated at Owens College, Manchester, and at the University of London, he went to America, and then to Jena, Germany, where he studied for some time. For years Gissing supported himself by teaching and writing under very adverse circumstances, continually suffering from poverty. His first romance, *Wonders of the Dawn*, appeared in 1878. Lower middle class life, the monotony of existence of the working men and of the shabby genteel, the suffering of souls in sordid environment, were the subjects which Gissing depicted in his subsequent novels, *Demos*, *Thyrza*, *The Unclassed*, *The Nether World*, *New Grub Street*, and *The Odd Woman*, all gloomy and joyless, but

all poignantly realistic and inspired by a moral ideal. A brighter mood is revealed in his work, *By the Ionian Sea*, in the semi-autobiographical *Private Papers of Henry Ryecroft*, and in his monograph on Dickens. *Veranilda*, left incomplete at the author's death, appeared in 1904. Cf. F. Swinnerton, *Gissing: A Critical Study*.

Gitschin (yit'shin), a walled town of North-Eastern Bohemia, in Czecho-Slovakia, in a fine valley, on the Cidlina. It has a castle built by Wallenstein, whose residence it was. Pop. 9800.

Giulio Romano (jō'lē-ō rō-mā'nō), **Giulio Pippi**, or **de' Giannuzzi**, Italian painter, architect, and engineer, the most distinguished of Raphael's pupils, born at Rome about 1492, died at Mantua 1546. During the lifetime of Raphael he painted with him and under his direction, and imitated him in many of his productions. After Raphael's death in 1520 he and his fellow-pupil, Gianfrancesco Penni, were entrusted with the completion of the frescoes in the Hall of Constantine in the Vatican at Rome. In 1524 he went to Mantua, where he executed a series of remarkable works in architecture, painting, and engineering. The Palazzo del Te (palace of the T) was rebuilt and ornamented entirely by him, or under his direction. After the death of San Gallo in 1546 the building of St. Peter's was committed to him, but he died the same year. His style is closely modelled on that of Raphael, but is bolder and coarser. His influence has been considerable, and he had many followers, among them being Primaticcio. Shakespeare mentions him by name in *Winter's Tale*, v, 2, 106, as being the sculptor who made the statue of Hermione. He is well represented at Florence, Naples, Paris, Rome, and London (*The Infancy of Jupiter* in the National Gallery).

Giurgevo (jūr-jā'vō), a town in Roumania, on the Danube, opposite Rustchuk, the most important shipping port on the Roumanian side of the river. The Russians were defeated there by the Turks, 1854. Pop. 14,140.

Giusti (jūs'tē), Giuseppe, Italian satirical and political poet, born in 1809, died in 1850. He is considered by his countrymen as the rival of Béranger in popular lyrical poetry.—Cf. W. D. Howells, *Modern Italian Poets*.

Givenchy (Givenchy-lez-la-Bassée), a French village in the department of Pas-de-Calais, 2 miles west of La Bassée. It was the scene of fierce fighting during the European War. The battle of Givenchy, between the British and the Germans, was fought in Dec., 1914. In April, 1918, during the German drive to the Channel Ports, Givenchy was defended by the 55th Division and later by the 1st Division.

Givet (zhē-vā), a town of North-Eastern France, in the Ardennes, with leather manufactories and other industries. It was formerly a place of great

strategic importance, but the fortifications were dismantled in 1892, with the exception of the citadel of Charlemont. During the European War Givet was the scene of fierce fighting, Viscount French (then Sir John) stubbornly resisting here in Aug., 1914, against the Germans. Pop. 7010.

Givors (zhē-vōr), a town of South-Eastern France, department of the Rhône, and on that river, a centre of the coal trade, with iron-works, glassworks, silk-weaving and dyeing-works. Pop. 12,784.

Gizeh (gē'zā), a town of Egypt, on the left bank of the Nile, opposite Old Cairo. Some miles off are the celebrated pyramids, which have been named from it. There is a British School of Archaeology at Gizeh. Pop. 18,714.

Gizzard, a strong muscular part of the alimentary canal of birds, which enables them to grind their food. A gizzard occurs also in crocodiles, many gasteropods, certain cephalopods and crustaceans, earthworms, and wheel animalcules (Rotifers). In birds it is lined by a thick muscular coat, and usually contains pieces of gravel, &c., to facilitate the grinding process.

Glacial Epoch. From time to time in geological history a cold epoch has set in, affecting the earth as a whole, and promoting falls of snow in place of rain. The conditions that favour the growth of glaciers have thus prevailed in low as well as high latitudes, and at low as well as high altitudes. Large areas have in consequence become covered by ice, while irregularities of precipitation have caused a slow movement outwards from certain centres, where the snow-domes rose sufficiently high to render the plastic ice-masses independent of the underlying land-surface. While pre-existing valleys at first guided the ice-tongues along their floors, the continuous precipitation of snow produced ice-sheets (*continental glaciers*) that moved across ridge and dale, collecting, like the massive glaciers of Greenland and Alaska, the soils and taluses formed by previous denudation, and carrying the materials into regions hundreds of miles from their place of origin. Armed with these tools, the ice-sheets scoured the floor over which they moved, and plucked away blocks that projected, until a hummocked surface was imparted even to the hardest rocks. The characteristic forms named *roches moutonnées* (rocks like a sheep's fleece or a frizzled wig) by H. B. de Saussure, before their mode of origin was realized, and the smoothing and striation of their surfaces (*roches polies*), are the surest signs of the former passage of land-ice. The huge *erratics*, blocks imported from a distance and stranded in striking positions on plateaus or on mountain sides, were formerly attributed to the Noachian deluge, or to some similar cataclysm affecting the whole globe.

In 1815 J. P. Perraudin, a chamois-hunter, called De Charpentier's attention to the evidence of the former extension of glaciers in the valley of the Rhône. In this he was the pioneer who opened up an entirely new range of observations; and when L. J. R. Agassiz some twenty years later invoked the agency of a general mantle of ice about the earth, he caught the attention of the catastrophists and laid the foundation for the recognition of a glacial epoch. The exaggeration connected with his views led, however, to a reaction, the effects of which are still noticeable in certain English writings, and floating ice was regarded as responsible for much of the deposits of boulder-loam. None the less, the existence of a cold epoch following on the Pliocene period became generally accepted, and research has now shown that it affected regions far beyond the polar areas. Ice-sheets are thus clearly traceable in the United States into the lowlands of Illinois, while in Russia the debris of Scandinavia was carried to the basin of the Don. G. de Geer's ingenious measurements of the annual deposits of sand and loam from the melting ice-front in the east of Sweden show that the passing of the latest ice-epoch from Europe occurred about 7000 B.C.

The spread of man in Europe was, indeed, for a long time limited by the presence of the ice, and early hunters fed their families in Southern France and Switzerland on animals now associated with Arctic climes. Though only one stage of ice-retreat, with a subsequent ice-extension, seems traceable in the British Isles, three interglacial stages have been proved by Penck and Brückner for the Alps (*Die Alpen im Eiszeitalter*, 1901-9), indicating fluctuations of climate that cannot be accounted for by movements of elevation or depression of the chain. Attempts to connect the ice-extension generally with the prevalence of high land-masses at the close of Pliocene times have similarly failed, and attention has been directed to possible astronomical causes or to changes in the absorptive power of the atmosphere for solar rays. The simplest suggestion would seem to be that the radiation of heat from the sun varies at different stages of its evolution; but of this there is no proof, and the causes of world-wide cooling and world-wide warming remain obscure. When a cold epoch has once set in, precipitation of moisture is likely to be checked through absence of adequate evaporation. But it must be remembered that all precipitation will be, over very wide areas, in the solid form. Five inches of 'rainfall' will perpetuate an ice-mantle, provided that this 'rainfall' occurs below freezing-point, and that all the moisture deposited is, therefore, in the form of ice-crystals.

The discovery of abundant evidence of a

world-wide glacial epoch in early Permian times, affecting in a very marked degree what are now tropical regions of the earth, has added greatly to the interest of the problem. The Talciferous Beds of India, long ago recognized as glacial, are now paralleled by the Dwyka conglomerates of South Africa, spreading from the Cape Province to Rhodesia, and by deposits of similar age in Australia, the Falkland Isles, and Brazil. When the 'glacial period' is spoken of, it usually means the ice-age of Pleistocene times; but a succession of such epochs, not necessarily at

their fronts. The first stage in their formation is the production of a mixture of snow and compact granular ice-crystals, called by French writers *névé*, by German authors *firn*. The ice of glaciers differs from that produced by the freezing of still water, being granular, a character that largely influences its downward flow. Glaciers are continually moving downwards, and not infrequently reach the borders of cultivation. The rate at which a glacier moves generally varies from 12 to 24 inches in twenty-four hours. At its lower end it is usually terminated by a



Glacier. The Mer de Glace, Chamonix

rhythmic intervals, has undoubtedly affected the physiography and the life of our planet, and possibly of the other planets of our system.

James Geikie, in the three editions of his *Great Ice Age*, undoubtedly did most to bring the reality and magnitude of the Pleistocene glacial epoch before readers in the British Isles. W. B. Wright (*The Quaternary Ice Age*, 1914) has admirably discussed and summarized recent work upon the subject.

Glaciers, ice-masses of great bulk, resulting from the compacting of snow as it accumulates on plateaus or in hollows above the snow-line, and becomes pressed outwards to lower levels. Glaciers may extend down valleys far below the snow-line, and may spread out in Arctic lowlands as confluent sheets which melt away along

steep slope. In its middle course it resembles a frozen stream with an undulating surface, broken by fissures or *crevasses*. As it descends it experiences a gradual diminution from the action of the sun and rain, and from the heat of the underlying earth. Hence a phenomenon universally attendant on glaciers—the issue of a stream of ice-cold turbid water from their lower extremity. The descent of glaciers is shown by changes in the position of detached masses of rock at their sides and on their surface. An important result of glacial action is the formation of *moraines*, which consist of accumulations of stones and detritus piled up on the sides of the glacier, or gathered within it, and deposited where it melts away. They are composed of fragments of rock detached by the action of frost, and also by the

plucking action of the moving ice. The fissures or crevasses by which glaciers are traversed are sometimes more than 100 feet in depth, and from being often covered with snow are exceedingly dangerous to travellers. One of the most famous glaciers of the Alps is the Mer de Glace, belonging to Mont Blanc, in the valley of Chamonix, about 5700 feet above the level of the sea. Glaciers exist in all zones in which mountains rise above the snow-line. Those of Norway are well known, and still larger glaciers of the Alpine or 'valley' type may be studied in the Himalayas. Glaciers of the 'continental' type occur in Greenland and Alaska, containing in their lower levels enormous quantities of rock-detritus, and capable of concealing and over-riding the features of the land-surface on which they rest (see *Boulder-clay*).

The problem of the descent of the glaciers is of extraordinary interest, and various theories have been put forward to account for it. It was shown by Professor J. D. Forbes, of Edinburgh, that a glacier progresses much like a river—the middle and upper parts moving faster than the sides and the bottom—and he showed that glacier motion was analogous to the way in which a mass of thick mortar or a quantity of pitch flows down in an inclined trough. His theory is known as the *viscous theory* of glaciers, which presupposes that ice is a plastic body, and this plasticity has been satisfactorily explained by Professor James Thomson, of Glasgow, by the phenomenon of the melting and refreezing of ice. Water, he discovered, when subjected to pressure, freezes at a lower temperature than when the pressure is removed. Consequently, when ice is subjected to pressure it melts; if it is relieved from pressure, the water again solidifies. Therefore if two pieces of ice are pressed together, or even rest against one another, they tend to relieve themselves by melting at their points of contact, and the water thus produced immediately solidifies on its escape. If ice is strained in any way, it similarly relieves itself at the strained parts, and a similar *regelation* follows. This gives an explanation of the plasticity of glaciers. Pressed downwards by the vast superincumbent mass, the ice gradually yields. Melting and refreezing take place at some parts, at others the gradual yielding at strained points goes on. In the latter process there is no visible melting, but there is the gradual yielding from point to point to the pressure above, and there is the transference from ice-granule to ice-granule of the molecules that constitute the apparently continuous mass. If, however, at certain points the strain is intense, continuity is lost, and crevasses occur, as when a glacier rounds a corner in a valley or spreads out in a terminal 'fan'. The plasticity of the individual ice-grains, each of which is a single

crystal, also plays an important part in glacier motion.

Glacier Tables, large stones found on glaciers supported on pedestals of ice. The stones attain this peculiar position by the melting away of the ice around them, and the lowering of its general surface by the action of the sun and rain. The block, like an umbrella, protects the ice below it, and accordingly its elevation measures the level of the glacier at a former period. By and by the stone table becomes too heavy for the column of ice on which it rests, or its equilibrium becomes unstable, whereupon it topples



Glacier Table

over, and, falling on the surface of the glacier, defends a new space of ice, which in time becomes a pedestal.

Glacis, in fortification, is the sloping surface of the outermost portion of a fortified line, descending from the parapet of the covered way to the level ground or open country in front. It must be so placed that the guns of the fort will rake it at every point.

Gladbach (Bergisch-) (berg'ish-gläd-bäh), a town of Prussia, province of Rheinland, 8 miles north-east of Cologne. Pop. 15,200.

Gladbach (Mönnen-) (meun'hen-gläd-bäh), a town of Prussia, province of Rheinland, 16 miles west of Düsseldorf, with extensive manufactures of cotton and mixed cotton goods, &c. Pop. 66,410.

Gladiators, combatants who fought at the public games in Rome for the entertainment of the spectators. The first instance known of

gladiators being exhibited was in 264 B.C., by Marcus and Decimus Brutus at the funeral of their father. They were at first prisoners, slaves, or condemned criminals; but afterwards freemen fought in the arena, either for hire or from choice; and eventually men of senatorial rank, and even women, fought. The regular gladiators were instructed in schools (*ludi*), and the overseer (*lanista*) purchased the gladiators and maintained them. Men of position sometimes kept gladiatorial schools and *lanistæ* of their own. The gladiators fought in the schools with wooden swords. In the public exhibitions (*spectacula*, or 'shows') the defeat of a gladiator was marked by a cry of 'Habet' from the spectators, who, if the vanquished fighter was not slain in the combat, decided his fate by the position in which they held their thumbs. While the general opinion is that by pointing the thumb downwards the spectators expressed their wish that the defeated gladiator should be put to death, and by pointing it upwards that he should be spared, some authorities maintain the opposite interpretation. The victor received a branch of palm or a garland. The gladiators were classified according to their arms and mode of fighting; thus there were *retiarii*, who carried a trident and a net (Lat. *rete*) in which they tried to entangle their opponent; *Thracians*, who were armed with the round Thracian buckler and a short sword; and *secutores*, who were pitted against the *retiarii*.—Cf. L. Friedlaender, *Roman Life and Manners under the Early Empire*.

Gladiolus, a genus of plants of the iris order, having a corm with a reticulated covering, natives of Europe and North Africa, but especially South Africa. The leaves are ensiform, the flowers brilliantly coloured. There are many species, some of them popular garden plants, others grown in hothouses.

Gladstone, Rt. Hon. William Ewart, British statesman, son of Sir John Gladstone, was born at Liverpool in 1809, and died at Ilawarden in 1898. After some years at Eton, he entered Christ Church, Oxford, in 1828, and graduated in 1831 with high honours. After leaving Oxford he spent six months in Italy. In 1832 the first Reform Act was passed, and Gladstone's public career commenced by his being returned for Newark, and when Peel assumed office in 1834 he accepted the post of Junior Lord of the Treasury. At this period he was a Tory, and as his party quickly went out it was not until 1841 that he again held any public office, in which year he became, under Peel, Vice-President of the Board of Trade and Master of the Mint. In 1842 great fiscal reforms were inaugurated, some of which were understood to be due to Gladstone. Having become President of the Board of Trade, he carried, in 1843, a measure

for the abolition of restrictions on the exportation of machinery, and in 1844 he carried a railway Bill, establishing cheap trains. He took part with Peel in the repeal of the Corn Laws, a course which cost him his seat for Newark. In 1847 he was returned for Oxford University, and he then supported the Bill for the removal of Jewish disabilities, and that for the repeal of the Navigation Laws. He now began to develop remarkable ability as a financier, and fiercely attacked Disraeli's Budget of 1852. The same year he became Chancellor of the Exchequer under the Earl of Aberdeen, a post which he also held for a short time in 1855 under Lord Palmerston. In 1858 he became High Commissioner Extraordinary to the Ionian Islands, and his *Studies on Homer* appeared about the same time. In 1859 he again took office as Chancellor of the Exchequer under Lord Palmerston. At the general election of 1865 Gladstone was returned for South Lancashire, and on the decease of Lord Palmerston he became the Liberal leader in the Commons in the Russell administration, still continuing to hold the Chancellorship of the Exchequer. The Government, being defeated on the Reform question, went out in 1866, and Lord Derby came into power. In 1867 a Reform Bill, establishing household suffrage in boroughs, was carried by the Conservatives, but to the final shape of it Gladstone and Bright materially contributed. In 1868 Gladstone succeeded in abolishing compulsory Church rates, and he also carried his resolutions dealing with the Irish Church, but his Irish Church Suspensory Bill was rejected by the Lords. At the general election of 1868 he lost his seat for South Lancashire, but was returned by Greenwich. There being a great Liberal majority in the new Parliament, Disraeli was soon forced to resign, and Gladstone became Premier. Next year he carried his Bill for the Disestablishment of the Irish Church, and in 1870 his Irish Land Act, the English Education Act being also passed. In 1871 army purchase was abolished by royal warrant. The Ballot Act and the Scottish Education Act were passed in 1872. Parliament was dissolved in 1874, and the Conservatives ousted Gladstone from office, as they had secured a good majority. During Lord Beaconsfield's tenure of office Gladstone denounced the Bulgarian atrocities, the Anglo-Turkish Treaty, and the Afghan War, and his speeches during his candidature for Midlothian greatly helped to render the Government unpopular. In 1880 the general election reinstated Gladstone firmly in power (Midlothian being now his constituency), and his second Irish Land Bill became law in the following year. In 1882 a Prevention of Crimes and an Arrears Act for Ireland were passed, and in 1883 measures

relating to bankruptcy were also carried. In 1884 the Bill extending household suffrage to the counties was carried, and the Gladstone ministry fell the next year. Lord Salisbury, who had formed an administration, got the Redistribution of Seats Bill passed, and under it took place the general election of 1885, Gladstone still continuing to represent Midlothian. Next year Lord Salisbury resigned after an adverse vote in the Commons, and Gladstone again came into power. He now introduced a Home Rule Bill for Ireland (8th April, 1886). It failed to pass the Commons, and the result of the general election which followed was emphatically adverse to Gladstone's proposals. He had to make way for Lord Salisbury, but in 1892 he again became Premier. After passing a Home Rule Bill through the Commons he resigned office in 1894, and next year retired from political life. His works include: *The State in its Relations with the Church* (1838), *Studies on Homer and the Homeric Age*, *Juventus Mundi*, *Homeric Synchronism*, *Landmarks of Homeric Study*, *The Impregnable Rock of Iliad Scripture*.—BIBLIOGRAPHY: Lord Morley, *Life of William Ewart Gladstone*; G. W. F. Russell, *Biography of W. E. Gladstone*; J. McCarthy, *The Story of Gladstone's Life*; Williamson, *W. E. Gladstone, Statesman and Scholar*; H. Paul, *The Life of W. E. Gladstone*; Lord Eversley, *Gladstone and Ireland*.

Glagolitic Alphabet, an ancient Slavonic alphabet, based on the Greek, and used in many old religious works, while in others the Cyrillian letters (q.v.) are employed. Glagolitic is derived from the Old Church Slavonic word *glagolati*, to speak.

Glaisher, James, born 1809, aeronaut and meteorologist, long connected with Greenwich Observatory, author of various books; died 1903. He made twenty-eight balloon ascents, in one of which he reached a height of 37,000 feet. He was the founder of the Royal Meteorological Society, and in 1849 he became a Fellow of the Royal Society. Among his works are: *Hygrometric Tables*, and *Travels in the Air*.

Glamor'gan, or **Glamorganshire**, a county in South Wales; area, 520,456 acres. The north and north-east parts of the county are extremely mountainous, and include scenery of the most romantic beauty. The southern portion is comparatively level and very fertile, particularly the vale of Glamorgan. The climate in this part is remarkably mild, as snow does not lie long on the ground, and tender shrubs thrive in the open air. Glamorganshire belongs wholly to the basin of the Severn; and all its streams, of which the Taff is the largest, flow southward. The cattle are reckoned among the best in Wales. The mineral wealth of Glamorganshire is of incalculable value. Its coal-fields in particular

are most extensive, and yield the best quality of steam-coal, and there are great ironworks (Dowlais, Cyfarthfa, &c.). The woollen manufacture is carried on to some extent. Principal towns: Cardiff (the capital), Merthyr-Tydfil Swansea, and Neath. Since 1918 the county returns seven members to the House of Commons. Pop. 1,252,701 (1921).

Glance, a name given to some minerals, generally sulphides, which possess a brilliant metallic lustre; as *antimony glance*, *bismuth glance*, *copper glance*, &c.

Glanders, one of the most formidable diseases to which horses are subject, indicated by a discharge of purulent matter from one or both nostrils, with a hard enlargement of the submaxillary glands. In acute glanders the discharge, by its copiousness, impedes respiration and ultimately produces suffocation. The disease is highly infectious, and may even be communicated to man by the purulent matter coming in contact with any part where the skin is broken. The disease is rarely, if ever, cured. See *Farcy*.

Glands, a certain class of structures in animals, some of them forming organs, which elaborate, from the material supplied by the blood, a fluid secretion which is conveyed by a duct into some hollow organ like the mouth, stomach, or intestine; or in other cases (ductless glands) is taken up again by the blood, to be distributed to the body as a *hormone*, a special chemical regulator of the growth and metabolism of different elements in the body. In man there are two lachrymal glands, situated at the external angle of the eyes under the upper eyelid; six salivary, to pour fluid into the mouth, of which three are on each side, behind and under the lower jaw; two parotid, two submaxillary, two sublingual; two mammary glands to secrete milk (the breasts of women); the liver, the pancreas, the two kidneys, as well as a vast multitude of small glands in the skin (sweat and sebaceous) and in the lining membrane of the stomach, intestines, and, in fact, most of the hollow organs. Of the ductless glands the most important are the thyroid, thymus, suprarenal, pituitary, in addition to a large number of smaller glands. The lymphatic glands, which filter the lymph, are somewhat different from these in character; and still more different are the blood-glands, such as the spleen. Botanists have given the name of glands to small bodies observed upon the surfaces of plants, many of which secrete certain fluids.

Glanvil, or **Glanville**, Ranulph de, English lawyer and warrior of the twelfth century. In the reign of Henry II he held the office of justiciary, and repelled the invasion of William the Lion, King of Scotland, who was taken prisoner as he was besieging the castle of Alnwick.

Richard I is said to have imprisoned Glanvil, and obliged him to purchase his freedom with £15,000 towards a crusade to the Holy Land. He accompanied his master on this expedition, and perished at the siege of Acre in 1190. To Glanvil is attributed a treatise on the laws and customs of England (*De Legibus et Consuetudinibus Angliæ*), written about 1181, and first printed in the year 1554 (at the instance of Sir W. Stanford), being the earliest treatise on English law. An English translation of the work, with an introduction by John Beames, appeared in 1812.

Glarus (glä'rös), a Swiss canton, surrounded by St. Gall, the Grisons, Uri, and Schwyz; area, 267 sq. miles. On all sides, except towards the north, Glarus is walled in by lofty mountains; lakes are numerous, and the scenery in their neighbourhood is magnificent. The inhabitants are chiefly engaged in the cotton manufacture and in agricultural pursuits, rearing sheep and cattle, and exporting cheese, butter, &c. The Constitution is a pure democracy. Pop. (1920), 33,639. The capital, Glarus, situated on the Linth amid grand scenery, is a well-built town, with a good trade. Pop. 4877.

Glas'gow (Celt. *Cleschu*, subsequently *Glasghu*, from *glas*, green, and *ghu*, dear), the largest city in Scotland, and the second largest in the United Kingdom, is situated mainly in the county of Lanark, on both banks of the Clyde, the larger and more important part of it on the right or north bank. In 1893 Glasgow was made a county by itself, and the Lord Provost appoints the deputy-lieutenants and justices of the peace. The southern portion of Glasgow is built mainly on low-lying level ground, the northern portion to a great extent on a series of elevations. Since 1912 the city includes also Govan and Partick, formerly separate municipalities. The river is crossed by ten bridges (including railway bridges) and by ferries; and there are also tunnels under it. The streets are mostly wide and straight, running mostly at right angles east and west and north and south. Of the former the chief are Argyle and Sauchiehall Streets; of the latter Renfield and Buchanan Streets. The houses are built almost wholly of freestone, and as a whole Glasgow is now excelled by few cities in the kingdom in architectural beauty. Of the buildings the Cathedral, situated in the north-east of the city, is the most noteworthy. Certain parts of the present fabric date from the twelfth century, but most of it belongs to the three following centuries. It is a large Gothic edifice in the Early Pointed style, with tower and spire from the centre. It is especially distinguished for the beauty of its crypt or lower church, one of the most perfect in Britain. The University buildings, erected after the designs of Sir George

Gilbert Scott on the removal of the college to the west-end in 1870, cover about 4 acres of ground on a noble site. They form an oblong rectangular pile in the Collegiate Gothic style of the fourteenth century, divided into two quadrangles, united by a centre building, and with a high tower. To the south lie the splendid new Art Galleries and Museum. The Municipal Buildings, in George Square, completed in 1887, form an imposing pile in the Renaissance style. Among other noteworthy buildings are various churches, the Royal Infirmary near the cathedral, the Western Infirmary near the university, the Victoria Infirmary in the southern suburbs, Ruchill Hospital, Belvidere Hospital, the United Free Church College, Royal Exchange, Stock Exchange, County Buildings, Athenæum, General Post Office, the new buildings of the Technical College, Christian Institute, the People's Palace, picture-houses, club-houses, banks, and insurance offices, some of the last new and noteworthy structures, and the large terminal stations (Central, St. Enoch, Queen Street). Most of the public monuments are collected in George Square. In addition to the extensive open space called the Green, Glasgow has a number of fine public parks, while some years ago a large tract of mountain-land on the Firth of Clyde was presented to the city, and in 1915 the Corporation purchased the magnificent stretch of country on the Braes of Balloch, since known as Loch Lomond Park. There are also Botanic Gardens with extensive hothouses. There is a public museum, and a large and valuable collection of pictures belonging to the city. The principal libraries are the University Library; the Mitchell Library (for which a fine new building was erected), the Stirling's and Glasgow Public Library, and the Baillie's Institution Library, all free reference libraries; the libraries of the Faculty of Medicine, the Faculty of Procurators, and other learned bodies; and also a large number of free district lending libraries. St. Andrew's Halls are the finest suite of public halls, and the City Hall is also a notable meeting-place. There are numerous theatres, music halls, and picture-houses. The principal cemetery is the Necropolis, on a rising ground near the cathedral, and full of fine monuments. Among educational institutions, in addition to the university, are Anderson's College Medical School, the Royal Technical College, the United Free Church College, Queen Margaret College for Women, St. Mungo's College, the normal or training institutions for teachers in Glasgow district, the Glasgow School of Art, the Glasgow Athenæum, the West of Scotland Agricultural College, the Veterinary College, the High Schools (Boys' and Girls') under the Education Authority, the Glasgow Academy and Kelvinside Academy (both pri-

vate), Allan Glen's School, St. Aloysius' College (R.C.), and the Hutchesons' Grammar Schools. In addition to the infirmaries and hospitals the benevolent and charitable institutions include the Eye Infirmary, Blind Asylum, Maternity Hospital, Hospital for Sick Children, Samaritan Hospital for Women, and lunatic asylum. There are also military barracks. The industries include cotton, linen, woollen, silk, and jute; calico-printing, dyeing, and bleaching; pig and malleable iron and steel; brass and copper; iron tubes and pipes, bolts and rivets, armour-plates, bridges, roofs, and other forms of metal work; general mechanical engineering, boilermaking, locomotives, textile machines, sewing machines, machine tools; shipbuilding, which might perhaps be called the staple; chemical works, potteries, glassworks, brickworks, breweries, distilleries, tanneries, tobacco-works, sugar-refining works, and soapworks. The commerce is also great and varied. The river itself, the chief highway of commerce, has been made navigable for large vessels up to the heart of the city, and there is extensive harbour accommodation, partly in the river and partly in the connected docks. The value of imports in 1912 was over £16,000,000, that of exports was over £32,000,000. The total net tonnage entered and cleared at Glasgow in 1918, excluding coastwise vessels, amounted to 3,576,000 tons. The improvement of the navigation of the Clyde, which within the nineteenth century was fordable at and below the present harbour of Glasgow, has been of immense service to the city, though the cost has also been immense. The railways are, of course, the chief means of inland traffic, and the Forth and Clyde and Monkland Canals form auxiliaries. Electric tramways pass along the principal streets, and connect Glasgow with Paisley and other places. There is a cable subway in the city. The city is excellently supplied with water from Loch Katrine, a distance of about 30 miles. The works are now capable of supplying 110,000,000 gallons daily.

The origin of Glasgow may be traced to the foundation of the cathedral by St. Kentigern (or Mungo) about 560. The bishopric was founded in 1115. Glasgow was erected into a burgh of barony about 1180, and for long the bishop had great powers over it. It became a free royal burgh in 1611. Glasgow Fair, now the chief holiday season of the city, was instituted about 1190. The Clyde was already crossed by a bridge in the thirteenth century, but the earliest stone bridge dates from the fourteenth. The Provost (now Lord Provost) is first mentioned in 1454. A convent of Dominicans or Black Friars was founded in 1246, and a Franciscan house in 1476. Wallace is said to have defeated an English garrison in the city, and other battles or skir-

mishes have occurred within its present limits, notably Langside (1568). The General Assembly which abolished Episcopacy in Scotland met in Glasgow Cathedral in 1638. Port-Glasgow was founded as the port of the city in 1668, but in the following century the deepening of the river up to the city was begun. In 1715 and 1745 Glasgow was conspicuously loyal to the reigning family. Up to the Union its trade was chiefly with the European continent. The Union opened up the trade with the American colonies, and tobacco became a source of wealth to the Glasgow merchants. Afterwards commerce began to take other directions. The Monkland Canal was made in 1770, and the Forth and Clyde Canal was opened in 1790. The pioneer steamboat *Comet* began to ply on the Clyde in 1812. Gas-lighting was introduced in 1816, and electric lighting in 1890. Street tramways were started in 1872. Since 1894 they have been municipal, and in 1898 electric traction was introduced. From the Union to 1832 Glasgow joined Rutherglen, Renfrew, and Dumbarton in sending a member to Parliament; from 1832 to 1868 it had two, from 1868 to 1885, three, from 1885 to 1918 it had seven members, and since 1918 it sends fifteen members to the House of Commons. Successful international exhibitions were held in 1888 and 1901. In 1920 Glasgow adopted the town of Vouziers in France. Pop. in 1610, 7644; in 1712, 13,832; in 1801, 77,385; pop. of municipal borough in 1901, 775,561; in 1911, 784,455; in 1921, 1,034,069.—BIBLIOGRAPHY: A. Macgeorge, *Old Glasgow*; Sir J. D. Marwick, *Early Glasgow*; J. A. Kilpatrick, *Literary Landmarks of Glasgow*; G. Eyre-Todd, *The Story of Glasgow*; Renwick and Lindsay, *History of Glasgow*.

Glasgow University was founded by a bull of Pope Nicholas V, 1450-1, which conferred not only the power of creating masters and doctors, but privileges and immunities identical with those of the University of Bologna. In 1577 James VI prescribed rules for the government of the university, giving it a new charter. It has been reconstituted by the Scottish Universities Acts of 1858 and 1889, and its constitution is similar to that of the others. (See *Edinburgh University*.) The old university buildings and ground were sold to the Glasgow Union Railway Company in 1864 for £100,000, a sum which, supplemented by university funds, Government grant, public subscriptions and donations, enabled upwards of £600,000 to be expended on fine new buildings in the west end of Glasgow. The university comprises five faculties, viz. arts, science, divinity, law, and medicine. With it is incorporated Queen Margaret College for women. The exhibitions, scholarships, bursaries, &c., from funds administered by the university, have an annual value of about £8000. The most valuable

are the George A. Clark scholarships, four in number, tenable for four years, and each about £108 in annual value. The examinations for these are respectively in classics, mental philosophy, mathematics, and natural science. The Snell Exhibition (annual value £100) and the Newlands Scholarship (annual value £80) are held conjointly for four years at Balliol College, Oxford University. There are also three Euing Fellowships, value £100 each, a Black Theological Fellowship, value £133; the Metcalfe Fellowship, value £100, besides others. The degrees conferred are almost the same as at Edinburgh. There were 164 professors and lecturers and 3900 matriculated students in 1920. Since 1918 the University of Glasgow unites with the other Scottish universities (St. Andrews, Aberdeen, and Edinburgh) in returning three members to Parliament. The university library numbers over 200,000 volumes.

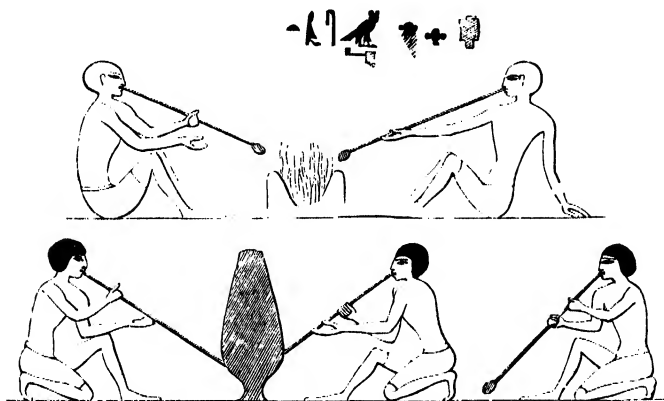
Glass is a comparatively hard and brittle substance having no visible crystalline structure. It has a characteristic conchoidal fracture, and a surface that naturally reflects or refracts light

bottles and chemical vessels, owing to its power of resisting the solvent or corrosive action of most liquids and acids. It is readily soluble in hydrofluoric acid. Its decorative value is great, and to a small extent it is used as an electrical insulator. It is a bad conductor of heat, being about 120 times worse than iron, and six times worse than quartz. When glass is heated sufficiently, it can be cast, blown, drawn, or moulded to any desired form, or even spun into fine threads. The physical constants of an average type of crown glass are as follows:

$$\begin{aligned}\text{Young's Modulus } E &= 700/10^6 \text{ grammes/sq. cm.} \\ \text{Rigidity Modulus } N &= 240/10^6 \text{ grammes/sq. cm.} \\ \text{Refractive Index } N_D &= 1.517. \\ \mu \text{ value, } \frac{N_D - 1}{F - C} &= 60.5.\end{aligned}$$

History.—Nothing is known of the origin of glass manufacture. That the art is extremely ancient is evident from certain pictures on tombs at Thebes, dating from about the year 1400 B.C., which represent processes closely resembling the hand methods of the present day. The art in

a highly-developed state was practised by the Assyrians, Phœnicians, Greeks, and Etruscans. When Egypt was subjugated by Cæsar Augustus about the year 26 B.C., glass formed part of the tribute imposed upon the conquered nation, and in the reign of Tiberius, about forty years later, the industry, according to Pliny, was already well established at Rome. In the Middle Ages Venice was renowned for its artistic glass productions. To avoid the risk of fire, the industry, by an edict dated 8th Nov., 1291, was transferred from Venice to the adjacent Island of Murano, which is still renowned for



Glass-blowing in Ancient Egypt

From the wall-painting in the Tomb of Beni Hassan, Thebes (after Wilkinson).

regularly. Although it occurs in nature as obsidian, which has no commercial value, glass is essentially an artificial product, resulting most generally, but not invariably, from the fusion of silica with metallic oxides. Transparency is the most valuable of its physical qualities, which may be varied through every degree of translucence and colour by suitable combinations of the ingredients. It is most extensively used as window glass. Special types of very transparent glass having particular refractive and dispersive powers are essential for the manufacture of optical instruments. It provides a suitable material for the construction of utensils such as

its glass bead and decorative glassware manufactures. Glass was certainly used for the glazing of windows towards the end of the third century. It was first generally used for this purpose in Italy. Although Abbot Benedict, in A.D. 674, caused the windows of the monastery of Wearmouth, Durham, to be glazed by foreign artists, it was many years thereafter before its use for this purpose became general in Britain.

The development of optical glass is due to the work of many practical and scientific workers. Guinand, a Swiss watchmaker, discovered about the year 1790 a method of stirring optical glass, and in 1800 he was able to produce homogeneous

discs of glass suitable for the construction of telescope objectives. Later, in association with Fraunhofer at Munich, the process was further developed. About 1827 the son of Guinand became associated with Bontemps and Lerebours in the manufacture of optical glass in Paris. The work in France was continued later by Charles Feil, and still more recently by Messrs. Parra Mantois & Co. Under the auspices of the Royal Society, Faraday in 1824 commenced his investigations, first at the Falcon Works of Messrs. Green & Pellatt, and later in the laboratories of the Royal Institution. Dolland was associated with Faraday in this work. Between the years 1834 and 1871 Harcourt, an English parson, greatly increased the number of metals that could be utilized in the manufacture of optical glass and the knowledge of their physical properties. From the year 1862 he was assisted in this work by Stokes. Owing to political troubles in France, Bontemps left Paris in 1848, and became associated with Messrs. Chance Brothers of Birmingham, who until 1915 were the only manufacturers of optical glass in the British Empire. Since that date optical glass has also been regularly produced by The Derby Crown Glass Company, and, for their own use, by the rangefinder manufacturers, Messrs. Barr & Stroud, Limited, of Glasgow. In Germany about the year 1880 the experimental work of Harcourt was revived under more favourable circumstances by Schott and Abbe, who with State aid established in Jena the factory of Schott und Genossen, which has produced many valuable types of optical and other special glasses.

Classification.—Glass may conveniently be classified according to its use, as, for example: (1) *Window glass*, including: hand blown and flattened; mechanically blown and flattened; continuously mechanically drawn; rolled and polished plate glass; corrugated and figured. (2) *Bottle glass*, including: hand blown and automatic machine-made bottles. (3) *Pressed glass*. (4) *Blown glass*, including: chemical and temperature resistant glassware; hand blown and finished without moulds; hand blown in moulds; drawn tubing. (5) *Optical glass* of very many varieties.

With the exception of optical glass, which for most purposes must be as transparent as possible, any of the above types of glass may be clear or coloured.

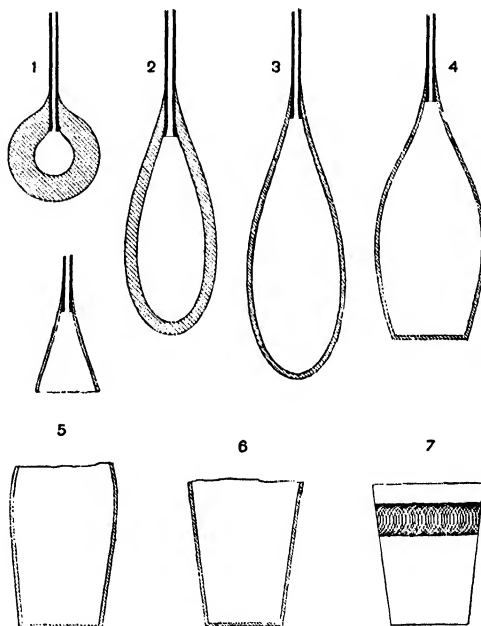
Composition.—Silica is the principal ingredient of practically all glass, although some types of optical glass contain no acid silica, its place being taken by phosphoric anhydride (P_2O_5) or boric oxide (B_2O_3). Silica itself is highly refractory. It can be softened under the oxyacetylene blow-pipe flame. Silica ware is now extensively

used in the laboratory and the chemical industry, owing to its power of resisting rapid changes of temperature. Many substances are available for fusion with silica to form glass, and such fusion may take place at the ordinary furnace temperature of about 1200°C . to 1400°C . Silica with an alkaline oxide produces a glass which is hygroscopic. If, however, an alkaline earth metal such as lime be added in the requisite proportion, the glass may be made durable, particularly as regards resistance to atmospheric corrosion. Addition of lime increases the temperature at which the glass is fluid. The alkaline earth metal may be replaced by other materials, such as lead oxide, which is an important ingredient of flint glass. An excess of some constituent may, during slow cooling, result in opalescence of the glass or even devitrification of the mass, although at the higher temperatures or when cooled rapidly the glass may be quite transparent. Fluorides, phosphates, and arsenic produce opalescent glass, which is often used for decorative purposes. The constituents of glass and their proportions within limits may be greatly varied, according to the type of glass required. Clear hard crown glass suitable for window glazing may consist of silica 72 per cent, lime 11 per cent, soda 17 per cent. Glass for blown ware may be either crown or flint. For the most brilliant cut-glass table ware, flint having a composition of silica 55 per cent, lead 10 per cent, and potash 35 per cent may be used. Chemical glassware may contain boric oxide, zinc oxide, and alumina. Many varied and beautiful colours are obtained by the introduction of metals or metallic oxides, but to some extent the colours depend upon the composition or conditions of working. Thus a small quantity of iron will colour a heavy lead glass more intensely than a crown glass. Traces of cobalt produce a strong blue; copper may give the same colour; gold and copper colour glass ruby-red, and chromium green. Uranium produces a yellow-green glass, which is also fluorescent and is used for making X-ray screens. A minute proportion of iron colours glass green. Manganese imparts a reddish-violet colour. To obtain sand entirely free from iron is extremely difficult; even Fontainebleau sand, used for optical glass, contains about 0.01 per cent Fe_2O_3 . For purposes other than optical, a slight green coloration of the glass may be neutralized by the addition of manganese or special decolorizers. There is reason to believe that the coloration of glass is due to the presence of the colouring substance in an extremely fine state of division.

Manufacture.—For the melting of comparatively small batches of glass, fire-clay pots are used. Tank furnaces are used for the large quantities required in the manufacture of window glass or the mass production of bottles. Fire-clay,

free from iron impurities and having fire-resistant qualities combined with the necessary plasticity, such as is mined in the Stourbridge district, is commonly employed. After weathering, hand-picking, grinding, and mixing with the necessary water, its plasticity is considerably improved by working or pugging and natural maturing. As the clay contracts excessively when drying, it is mixed with 25 to 30 per cent of well burnt and ground clay called *grog*, which has principally the effect of reducing the contraction and the liability to fracture during the firing process. Usually the pots are built by hand, the small pieces of clay being well combined to avoid the inclusion of air. Wooden formers or moulds are sometimes used during the building operation to preserve the shape, which may be circular or oval. Most frequently the pot has a domed roof with a front port or opening just above the glass level through which the batch is inserted and the glass extracted, but for optical glass open pots are often used to facilitate the stirring operation. To a smaller extent the casting of pots in plaster of Paris moulds is practised. The moist clay or slip is rendered liquid by the addition of an alkaline electrolyte. After the slip has set, the mould is opened and removed. The pots are allowed to dry naturally in dry air for a period of several months. Before use it is slowly heated during about seven days in a pot arch, the temperature of which can be gradually raised, as the pot under a rapid change of temperature might otherwise crack, especially if it contains much included moisture or air. It is then transferred as rapidly as possible to the furnace, within which it is enclosed. One furnace often contains several pots grouped in a ring upon the floor or siege, with the port openings of the pots projecting through the furnace wall, thus giving access to them. The firing of the furnace is sometimes done by hand, but generally producer gas is employed, in which case the products of combustion are passed through regenerators or recuperators, which heat the air and gas before their combustion in the furnace around the pots, thus improving the thermal efficiency. The constituents of the batch are well ground and mixed, and to the batch is added a proportion of glass chips termed *cullet*, which facilitates the fusion of the ingredients. Before the batch is inserted the interior walls of the pot are glazed, to protect them from the highly corrosive action of the unmelted batch. During the melting much gas is evolved through the reduction of the carbonates, nitrates, and other ingredients. The separation of gas can be assisted by plunging a moist potato or new wood into the fluid glass. Large bubbles of steam thus formed in rising to the surface entrain minute gas bells, and also help to mix the glass more thoroughly. To plane or fine

the glass, as the operation is called, the temperature is raised to an extent dependent upon its nature. Of the several pots in the furnace, some are being filled or fined while the others are being worked, but in some installations the filling and fining operations are done during the night and the glass worked out during the day. Optical glass must be stirred as well as fined to destroy veins or *striae*, which are threads of glass throughout the mixture of slightly different re-



Hollow Glass-blowing

The stages in the manufacture of a tumbler. A quantity of glass is gathered on the blow-pipe and blown into a small bulb (1), which is blown out (2), and elongated by blowing and swinging (3). It is then flattened at the bottom by pressing on the "marver" (4). The glass is separated from the pipe (5), and is annealed in this shape.

fractive index, most frequently due to solution of the pot, or the fire-clay stirrer. From the pot the glass is gathered upon the end of a hollow blow-iron, and is then blown into the required shape, many beautiful results being obtained by skilful rotation and manipulation of the glass during the operation. For the production of incandescent globes and kindred articles, the gathered glass is blown within a mould which can be opened out to release the article. During the operation the tube is rotated, to prevent sticking and to produce a good surface. Blowing is done by the operator or by compressed air.

Glass can also be pressed solid in moulds into many shapes, such as pavement lights.

Window glass is hand-produced by gathering a large mass of glass on the blow-iron. It is formed into a cylindrical mass by rolling upon a smooth-shaped block called a marver. By careful blowing a hollow cylinder is formed. The mass of glass at the end of the cylinder is kept soft by frequent reheating, and, by swinging the mass and blowing, the cylinder is regularly extended, a uniform thickness of wall being obtained by skilful manipulation. After cutting off the cap and making a longitudinal cut, the cylinder is placed within a flattening furnace, upon the smooth floor of which it is opened out and flattened by means of a smoothing block. The plate is then removed and slowly cooled.

For the mass production of bottles and similar articles many ingenious automatic machines are employed, and the requisite glass is automatically gathered, siphoned, or drawn from the furnace. Tank furnaces are often used in conjunction with such machines, of which the O'Neill, the Owen, and the Westlake are typical examples. Tank furnaces vary greatly in size. Some of the larger gas-fired ones are capable of holding nearly a thousand tons of molten glass. The batch is inserted at one end of the tank and the molten glass is extracted at the other. Thus the process is a continuous one. The tank which holds the glass is built of large refractory blocks accurately machined and closely fitted together without any cementing material.

Large sheets of window glass may be rolled or drawn in cylinder or sheet form. In the rolling process for plate glass a ladleful of glass extracted from the furnace is poured upon a long table, upon which the mass is evenly distributed by a heavy roller. The sheet is then transferred to an annealing furnace. For the production of thick plate glass the comparatively uneven plate is afterwards ground and polished. Corrugated or figured glass is similarly produced by the use of a roller having a suitably corrugated surface. Long vertical cylinders, which are later cut longitudinally and opened out in a flattening furnace to form a sheet, are drawn mechanically from a special pot of molten glass extracted from the furnace. The diameter of the cylinder and the thickness of the wall are controlled by an automatic regulation of the internal air-pressure and the rate of drawing. In the still more recent Libby-Owens process a plane sheet is drawn.

Articles made of glass must be cooled slowly to avoid fracture, and still more slowly to anneal them, that is, to eliminate stresses that may ultimately cause them to break. If the thickness of the glass is very irregular, the thin parts may cool and set while the adjacent thicker parts are still hot and soft. As these thick parts cool they contract, and may severely strain the previously-cooled thinner portions. By slow uni-

form cooling these stresses can be greatly reduced. Annealing of optical glass is a most important operation, which may last for three to five weeks or even more in the case of very large pieces. For hollow ware and window glass much shorter periods are required. The articles while hot are placed upon a conveyor which passes through a heated tunnel or *lehr*, the temperature of which throughout its length is suitably varied. Thus in their passage the articles are brought to the required annealing temperature, and then gradually reduced in temperature.

The variety of types of glass produced for special purposes is now very great. For spectacles a good hard type of crown glass is employed. There are also manufactured special types that are partially opaque to ultra-violet rays, though quite transparent to visual rays of light. Crooke's spectacle glass and certain anti-glare glasses have these properties, which are often realized by the use of cerium and didymium salts. Uranium glass, commonly used for X-ray screens, fluoresces also under the action of ultra-violet light. It is a hard crown or borosilicate glass containing about 4 per cent of uranium. Ultra-violet glass, which has a dense violet colour, is opaque to most visual rays, but transparent to ultra-violet rays. It contains about 5 per cent of nickel oxide. Strass is a heavy lead glass having a high refractive index, coloured by the addition of various metallic oxides, and used for the production of imitation gems. Flashed glass is often used for decorative ware. The article may be partially blown in white glass and then dipped into coloured glass and fully blown. The wall thus consists of a thin layer of coloured glass upon white glass. By grinding or cutting or etching through the coloured layer, highly decorative effects may be obtained. Tubing is still generally produced by a hand process of drawing. A large mass of glass is gathered upon a blow-iron, and marvered and blown to the form of a thick walled cylinder. A second operator holds the pontil over his shoulder with the hot mass of glass near his back, which is protected by a leather guard. While the blow-pipe operator facing the mass walks backwards, the other walks forwards, and thus the mass of glass is drawn out between them into a tubular form, the size of which is controlled by the speed of separation and the skill of the blow-pipe operator. As the tube is formed it rests upon wooden straps laid ladderwise upon the floor of a passage, which may be two or three hundred feet long. For the formation of heavy tubing quick cooling of the drawn glass by fanning is necessary. However small the tube may be drawn, it will always be found to be hollow. Rod or cane glass is produced in a similar manner by drawing a solid mass of glass which has no initial internal air-

space. Tubes and canes of triangular, oval, or other special sections are produced by marvering the gathered glass to a corresponding shape. Many beautiful effects may be obtained by drawing. Filigree work, for example, is produced by combining with the marvered cylinder rods of coloured and opal glass arranged in parallel or interlaced patterns which may also be superposed. When the mass is drawn, the original pattern is preserved in an extended form. Millefiore effects are obtained by combining numerous pieces of coloured glass upon the surface of the gathered block of glass, and then blowing or drawing as previously described.

Spun glass is an extremely fine form of cane, the necessary speed of drawing being attained by winding upon the periphery of a rotating wheel.

Aventurine, first produced and for many years secretly manufactured by the Venetians, has a peculiar spangled appearance, due to partial reduction to the metallic state of copper throughout the mass. Reduction of chromium produces a similar green effect.

Toughened blocks of glass are frequently used as guards for boiler glass gauge tubes subjected to high pressure. The highly-heated block of glass is plunged into hot oil, which chills the surface without fracturing it while the interior still remains soft. As the interior cools it contracts, and places the surface under great compression. Surface cracks are therefore closed, instead of being extended, and the toughened plate can resist the application of very considerable external force that would otherwise break it.

Sheet glass can be reinforced by rolling into its substance while plastic a wire mesh of suitable material. Sheets of celluloid are also sometimes combined by cementing with two surface layers of glass to form so-called unbreakable glass.

Table and fancy glassware can be very effectively decorated in a great variety of ways. The patterns may be cut into the glass by grinding and polishing wheels, rouge or putty powder being used as a polishing medium. They may be etched by means of hydrofluoric acid acting upon portions of the glass surface, the remaining portions being protected by a coating of beeswax or bitumistic compound, which is later dissolved away, or the pattern may be sand-blasted through the apertures of a stencil laid upon the glass surface. The pattern may be transferred or hand-painted upon the surface with metallic vitreous paints, which, when heated, melt and combine with the surface layer, thus producing the desired coloured effects.—BIBLIOGRAPHY: *Journal of the Society of Glass Technology*; P. Marson, *Glass Manufacture*; W. Rosenhain, *Glass Manufacture*; W. A. Shenstone, *Glass Blowing*; A. B. Searle, *The Clay Workers' Handbook*; P. G. H. Boswell, *Sands for Glass-making*.

Glass, in folk-lore. Beads of glass, variously coloured, and found in ancient British and Irish graves and at sites of habitations, are known as 'fairy beads', 'Druid gems', or 'Druid glass' (W. *Gleini na Droedh*, and Gael. *Glaíne nan Druidhe*). Other names are 'adder stones', 'snake stones', 'serpent beads', &c. It was believed that the beads had been produced by snakes hissing together, and that one of them wriggled through the hole of the bead. In Cornwall the snakes were supposed to produce the blue bead, with a yellow figure of a snake (the spiral) on it, by breathing or spitting on a wand of hazel. Apparently the earliest glass beads used in Britain were imported as amulets and talismans. They had the virtues of the *ovum anguinum* of Pliny, protecting wearers against evil influences and assisting women at childbirth, &c. Glass objects were thus substitutes for 'luck stones', amber and pearls. Apparently they were regarded as products of water, like other substances that could be reduced to liquid form by means of fire. The Teutonic word 'glass' is derived from the same root as the Celtic *glas*, which originally meant 'water', as in *Duglas* (dark stream) and *Finglas* (white stream), and especially the water of a sacred river or lake in which dwelt a goddess. The Celtic *glas* had the secondary meaning of 'vigour', as in *Gaidheal glas* ('the vigorous Gael'). Vigour was promoted by charms worn by warriors, especially those of amber, pearls, and coral, as well as of gold and silver, and those of symbolic shape in other materials. The goddess Freyja of Northern mythology wept tears that were transformed into pearls, amber, precious stones, and precious metals. Amber, being a product of water, and especially of the goddess who had, like Aphrodite, her origin in water, was impregnated with the influence of the deity. According to Tacitus, amber was called *glesse* by the Baltic people of Celtic speech, who collected it and traded in it. Pliny says that the Germans called amber *glessum*, and that one of the amber islands of the Baltic was known as *Glessaria*. The root *glas* is found in French in *glace*, which means 'ice' and 'yellow amber'. In modern Gaelic and Welsh *glas* is a colour term signifying 'green' or 'grey' or 'greyish green'. In the Far East glass was, as in Western Europe, used for magic religious purposes. Objects of glass reached China from the west early in the Christian era. Glass rings were as 'precious' (sacred) as those of jade, or those of varieties of quartz. Thus the term *pi-liu-li* was applied in ancient texts to glass as well as to certain precious stones. In modern Chinese glass is *po-li*. The Japanese *maga-tama* (or 'comma-shaped') beads, which were sacred objects, were made of jade, agate, chrysoprase, serpentine, chalcedony, steatite,

quartz, crystal, and glass. A *tama* is an object containing the animating principle (soul substance), and the soul of a deity is called *mi-tama*, the *mi*, which originally meant a 'water-snake', being used as a honorific prefix. The glass beads found in Japanese prehistoric burial-mounds are coloured dark-blue as a rule, but some are green or amber coloured. It is believed that these glass beads were imported from or through China. The Chinese method of blowing glass was not introduced into Japan until the sixteenth century. It appears that the Chinese themselves became acquainted with glass as a result of contact with the Roman Orient. They did not begin to manufacture glass until the fifth century. During the early Iron Age in Europe the trade in glass charms, including beads and armlets, was widespread. The ancient Egyptians produced glassy objects as far back as their Empire period (c. 1000 B.C.), but it was not until Roman times that glass was blown. Glassy beads were coloured and used as charms in ancient Egypt. They were substitutes for precious stones, &c., of religious value.

Glassites, a religious body founded in Scotland in the eighteenth century by John Glass (1695-1773), a minister of the Established Church. They maintained certain practices, such as weekly communions, love-feasts, washing each other's feet, and mutual exhortations. They disapproved of all games of chance, and of all use of the lot except for sacred purposes. They are now extinct; their last church in America was closed in 1890.

Glass-painting, the art of producing pictures upon glass with colours that are burned in, or by the use of pieces of coloured glass, in which the colour forms part of the composition of the glass itself. Originally there was but one method of making ornamental glass windows, which was by the latter process: the pieces of stained or coloured glass were cut to the desired shape, and let into the grooves of finely-made leaden frames which formed the pattern in outline, so that the pictures resembled mosaic work. In the sixteenth century, the *enamel* colours having been discovered, a new process came into vogue, the designs being now painted on the glass and burned in. At the present day the two methods, or a combination of the two, are chiefly employed, the *mosaic-enamel* method being the most common, and consisting of a combination of these two. The chief seats of the art in Britain are Birmingham and Edinburgh; in France, Paris and Sèvres; and in Germany, Munich and Nürnberg.—**BIBLIOGRAPHY:** P. Nelson, *Ancient Painted Glass in Europe*; M. Drake, *History of English Glass Painting*.

Glass Paper, or **Cloth**, is made by strewing finely-pounded glass on a sheet of paper or

cloth which has been besmeared with a coat of thin glue, the glue being still wet. It is much used for polishing metal and woodwork.

Glass Snake, a lizard (*Ophisaurus apus*), in form resembling a serpent, and reaching a length of 3 feet. It is related to the *blind-worm* (q.v.). The joints of the tail are not connected by caudal muscles, hence it is extremely brittle, and one or more of the joints break off when the animal is even slightly irritated. It is native to the Balkans, South Russia, Morocco, and Asia Minor. Other species inhabit the Eastern Himalayas and North America, belonging to *Tetradon* and allied genera.

Glass'wort, a name given to the plants of the genus *Salicornia*, nat. ord. *Cheupodiaceæ*, succulent marine herbs growing abundantly on the coasts in the south of Europe and north of Africa, and yielding, by burning, ashes containing soda, formerly much employed in making both soap and glass. Two or three species are natives of Britain.

Glastonbury, a town of England, county of Somerset. It was famous for a thorn tree supposed to have been planted there by Joseph of Arimathea. It is closely connected with Arthurian legend, and is identified with the Island of Avilion, Arthur's burial-place. It also derives interest from the ruins of its once magnificent Benedictine abbey, dating back to the twelfth century, and now consisting of some fragments of the church, the chapel of St. Joseph of Arimathea, and what is called the abbot's kitchen. Its abbots sat among the barons in Parliament. The last, Abbot Whiting, was hanged on a neighbouring eminence, the Tor, by order of Henry VIII for refusing to surrender the abbey. The fifteenth-century Pilgrims' Inn is now the 'George'. In 1892 remains of two lake villages were discovered in the neighbourhood of Glastonbury. Sharpham Park, the birth-place of Fielding, lies 2 miles to the south-west of the town. Pop. (municipal borough), 4326.

Glatz, a town of Germany, province of Silesia, on the Neisse, 51 miles S.S.W. of Breslau; manufactures of linen, cotton, and woollen goods, leather, carpets, &c. Pop. 17,095.

Glauber, John Rudolph, a German chemist, born in 1603 or 1604. His life seems to have been somewhat unsettled—at least he resided in many different places—Vienna, Salzburg, Frankfurt, Kitzingen, Cologne, and Basel, and finally in Amsterdam, where he died in 1668. He is chiefly remembered for his discovery of sulphate of soda or *Glauber's Salt*, which he termed *sal mirabile*, in consequence of his great faith in its medicinal qualities. Glauber's *Opera Omnia* were translated into English in 1680.

Glauber's Salt, sulphate of sodium (Na_2SO_4 , $10\text{H}_2\text{O}$), so called because of the importance

attached to its chemical and medicinal properties by Glauber. It forms large colourless monoclinic prisms, which effloresce on exposure to the air. It is soluble in water, and when heated melts in its water of crystallization. It is found in many localities, dissolved in the water of mineral springs or of salt lakes, round which it effloresces.

Glauchau (glou'hau), a manufacturing town of Saxony, on the Mulde, 54 miles w.s.w. of Dresden. It has manufactures of woollens, carpets, linens, leather, dyeworks, print-fields, and worsted mills. Pop. 25,155.

Glaucō'ma, in medicine, an almost incurable disease of the eye, in which the eyeball becomes of stony hardness by the accumulation of fluid within, and the consequent increase of pressure causes disorganization of all the tissues. Loss of sight is sometimes very rapid. The progress of the disease may in some cases be arrested by pupil-contracting drugs or by surgical operation. Called also *Glaucosis*.

Glaucōnite, a soft green mineral occurring as an infilling of foraminiferal shells, sponge-spicules, &c., on the sea-floor at depths of about 100 fathoms, and left behind as internal casts of these objects when the covering-matter is broken or dissolved away. It is a hydrous silicate of iron and potassium, with some calcium, &c., and was formerly mistaken for chlorite. It is well known in the greensands (q.v.) of all ages, and its potash-content, some 3 to 8 per cent, adds to the fertility of soils formed on these rocks.

Glazing is the covering of earthenware vessels with a vitreous coating in order to prevent their being penetrated by fluids. The materials of common glass would afford the most perfect glazing were it not that a glazing of this sort is liable to cracks when exposed to changes of temperature. A mixture of equal parts of oxide of lead and ground flint is found to be a durable glaze for the common cream-coloured ware, and is generally used for that purpose. See *Pottery*.

Glebe (Lat. *gleba*, a clod of earth), land attached to an Established church for the benefit of the incumbent in addition to his stipend. It may be let out and may be sold with the approval of the Land Commissioners.

Gleditsch'ia, a genus of plants, ord. Leguminosæ, to which *G. triacanthos*, the honeylocust, belongs.

Glee (A.Sax. *gligg*, music), in music, a composition in three or more parts, generally consisting of more than one movement, the subject of which may vary greatly, from grave to gay. Instrumental accompaniment is illegitimate. Among glee composers were: Webbe, Stevens, Calcott, Horsley, Attwood, Lord Mornington,

and others. In 1787 a Glee-club was founded in London, and existed until 1857.

Gleicheniaceæ, a small family of Leptosporangiate Ferns, largely tropical, mostly smallish plants with creeping stems and dichotomously-branched leaves.

Gleiwitz (gli'vits), a town of Germany, in the plebiscite area of Upper Silesia (q.v.). It is situated on the River Klodnitz not far from Beuthen, and near the mines. It has foundries, machine-works, glassworks, worsted and other mills. Pop. 66,980.

Glencoe (glen-kō'), a valley in the county of Argyle, near the head of Loch Etive. It is bounded on both sides by almost perpendicular mountains over 3000 feet high, and is traversed by a mountain stream, Ossian's "dark torrent of Cona". The valley was the scene of a tragedy known as the Massacre of Glencoe. The state of the Highlands after 1690 was a subject of great anxiety to the Government. Although the Highlanders had ceased any important operations since the death of Dundee at Killiecrankie, they had not laid down their arms. In 1691 a proclamation was issued promising pardon to all who should swear allegiance on or before 31st Dec., 1691. All the chiefs but the chief of the MacDonalds of Glencoe complied. The latter had unfortunately exceeded the prescribed period, and a certificate which he produced to prove that he had offered to take the oaths at Fort-William was suppressed, as is thought, by Stair. The king's signature was obtained to an order to extirpate the MacDonalds. On the 1st of February a party of soldiers, 120 in number, commanded by Captain Campbell of Glenlyon, marched up the glen and took quarters as friends. The soldiers belonged mostly to the clan Campbell, enemies of the MacDonalds; but they were well treated, and all went merrily on for twelve days. At five in the morning of the 13th Glenlyon and his men suddenly fell on the MacDonalds. Thirty-eight men were murdered, but many who had escaped perished in the snow, sank into bogs, or died for lack of food. Much obloquy has been heaped upon King William on account of his share in the massacre, but the utmost of what he would seem to have been guilty was carelessness in signing without investigation the order mentioned above.—Cf. George Gilfillan, *The Massacre of Glencoe and the Campbells of Glenlyon*.

Glendalough (glen'da-loh), that is, 'glen of the two loughs', a picturesque vale near the middle of County Wicklow, Ireland, containing two small lakes, and ruins known as 'the Seven Churches', besides an old round tower; as an ecclesiastical centre it was associated with the name of St. Kevin as early as the sixth century.

Glendower, Owen, last national leader of

the Welsh people, born 1359. At an early age he was sent to London, and studied for the Bar, but relinquished the profession on being appointed an esquire to Richard II, whom he supported to the last. He carried on a contest with Lord Grey de Ruthyn respecting an estate, and the latter being charged with the delivery of a summons to Owen from Henry, to attend him on his Scottish expedition, purposely neglected to deliver it. Glendower was outlawed for disaffection, and his enemy seized upon his lands. Glendower dispossessed Grey of his lands, and, having raised a considerable force, caused himself to be proclaimed Prince of Wales on 20th Sept., 1400. He defeated the king's troops, and, retiring to the mountains, foiled all subsequent attempts to bring him to action. He afterwards joined the coalition of the Percys, against Henry, and was crowned 'sovereign of Wales'. Glendower arrived with his force too late for the battle of Shrewsbury; and, seeing all was lost, retreated, and continued his marauding warfare. This he kept up with various success, occasionally assisted by Charles VI of France. Finding it impossible to subdue him, Henry V, in 1415, condescended to treat with him; but Owen died during the negotiation.—BIBLIOGRAPHY: Thomas, *Memoirs of Glendower*; A. G. Bradley, *Owen Glyndwr: the Last Struggle for Welsh Independence*.

Glengarry, Scottish parish and glen, Inverness, traversed by the Garry, which issues from Loch Quoich, forms Loch Garry in its course, and enters Loch Oich, one of the Caledonian Canal lochs. Glengarry was the home of the Macdonalds from the sixteenth to the beginning of the nineteenth century. The glengarry bonnet is named from this valley. There are also a river, loch, and glen of same name in Perthshire.

Glenlivet, a valley or district of Scotland, in the county of Banff. Whisky of a particularly fine flavour has long been made in the district. In Glenlivet the Protestant army under the Earl of Argyre was defeated by a Roman Catholic force under the Earl of Huntly in 1594. Pop. 1263.

Glen Roy, a deep valley in the Highlands of Scotland, parallel to Glenmore (the Great Glen), in Lochaber, Inverness-shire. It is nearly 14 miles in length, and little more than $\frac{1}{2}$ mile in breadth, and is celebrated for its so-called *Parallel Roads*, which are three parallel terraces running along either side of the glen. Not only do the lines on the same side run parallel to each other, but on both sides they respectively occupy the same horizontal level. These terraces project, at some parts only a few feet from the hill-side and at others widen out so as to be a number of yards in breadth. The lowest terrace is 850

to 862 feet above the sea-level, the middle 1002 to 1077 feet, and the highest 1144 to 1155 feet. Their origin has been much disputed, but according to Macenloch, Agassiz, Buckland, and Geikie, the roads are shore-lines of freshwater lakes. As, however, no land-barrier is discoverable in the vicinity, they refer the lake or lakes to the Glacial period, holding that glaciers must have descended from Ben Nevis and dammed up the water in Glen Roy. As these glaciers did not disappear simultaneously, the surface of the lake had different elevations successively, and thus distinct shore-lines or beaches were formed at different times.

Glenilt', a mountain valley in Scotland, Perthshire, traversed by the Tilt, having its southern extremity at Blair Castle, and there opening into the valley of the Garry. Marble of a pure white, of a light grey, and of a beautiful green has been quarried in its recesses.

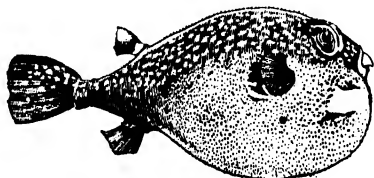
Globe, a sphere, a round solid body, which may be conceived to be generated by the revolution of a semicircle about its diameter. An artificial globe, in geography and astronomy, is a globe of metal, plaster, paper, pasteboard, &c., on the surface of which is drawn a map, or representation of either the earth or the heavens, with the several circles which are conceived upon them, the former being called the *terrestrial globe*, and the latter the *celestial globe*. Some celestial globes were made by Gerbert of Aurillac in the tenth century, and an Arabian celestial globe dating back to 1225 is in the museum at Florence. One of the oldest terrestrial globes is that of Behaim, constructed at Nürnberg in 1492. In the terrestrial globe the wire on which it turns represents the earth's axis, the extremities of it representing the poles. The *brazen meridian* is a vertical circle in which the artificial globe turns, divided into 360 degrees, each degree being divided into minutes and seconds. The brass meridian receives the ends of the axis on which the globe revolves. At right angles to this, and in a horizontal plane, is a broad ring of wood or brass representing the horizon; that is, the true horizon of the earth which lies in a plane containing the earth's centre. The horizon and brass meridian are connected with the stand on which the whole is supported. On the surface of the globe, as on other maps, are marked parallels of latitude, meridians, &c. On a globe of some size the meridians are drawn through every 15° of the equator, each answering to an hour's difference of time between two places. Hence they are called the *hour circles*. A number of *problems* or questions, many of them more curious than useful, may be solved by means of a terrestrial globe. Among the most important are: to find the latitude and longitude of a place, the difference of time between two

places, the time of the sun's rising and setting for a given day at a given place, &c.

Globe-fish, the name given to several fishes, ord. Plectognathi, remarkable for possessing the power of suddenly assuming a globular form by swallowing air, which, passing into a ventral sac, inflates the whole animal like a balloon. They are common in tropical seas, and freshwater species are also known.

Globe-flower, a popular name of *Trollius europæus* (nat. ord. Ranunculaceæ), a common European plant in mountainous regions, having five-lobed, deeply serrated leaves and round pale-yellow blossoms, the sepals of which are large and conspicuous, while the petals are very small. It is often cultivated in gardens, and is common in mountain pastures in the north of England, north of Ireland, Wales, and Scotland.

Globigerina, one of the perforate Foraminifera, a microscopic animal having a shell formed



Globe-fish (*Tetodon lineatus*)

of several nearly globular chambers; found fossil in the Chalk and Tertiary formations, and still so abundant in our seas that its shells after death form vast calcareous deposits of mud or ooze known as 'globigerina ooze'.

Globulin, a chemical compound belonging to the proteid class, found in the tissues of living organisms. The best-known forms occur in blood serum, in muscular tissue, and in the crystalline lens of the eye.

Glockner, or **Gross Glockner**, a mountain belonging to the Noric Alps, on the frontiers of the Tyrol, Carinthia, and Salzburg. It is 12,350 feet in height, and takes its name from the resemblance of the principal summit to a large bell.

Glogau, or **Gross-Glogau**, a German town and former fortress in Silesia, on the Oder, 54 miles N.W. of Breslau. It has a Lutheran and a Catholic gymnasium, some manufactories and a brisk inland trade. Its principal edifices are four churches, one of them formerly a cathedral. Pop. 24,524.

Glommen, the largest river in Norway, issues from Lake Oresund, about 2417 feet above the sea-level, in the south-east of South Trondhjem, flows generally south, and after a course of above 370 miles falls into the Skager-Rack at Frederikstadt.

Gloriosa, a genus of tuberous-rooted climbing herbs of the nat. ord. Liliaceæ, so named from the splendid appearance of its flowers. They have branched stems and flowers mostly of a beautiful red and yellow colour, with six long lanceolate undulated segments, which are entirely reflexed. *G. superba*, a native of India and tropical Africa, is cultivated in hothouses.

Glory Pea. See *Clianthus*.

Gloss, an explanation of some verbal difficulty in a literary work, written at the passage to which it refers. The earliest glosses, as those in Greek, Latin, and Hebrew MSS., were interlinear; they were afterwards placed in the margin, and extended finally in some instances to a sort of running commentary on an entire book.

Glossop, a municipal borough of England, in Derbyshire, 30 miles from Sheffield. It is the principal seat of the Derbyshire cotton manufacture, and there are also woollen- and paper-mills, iron-foundries, dyeing and bleaching and printworks. Pop. 20,528.

Glossopteris, a fossil plant with elongated leaves; allied to the ferns and also possibly to the cycads, characterizing widely distributed beds of Upper Carboniferous and Lower Permian Age. The 'Glossopteris flora' is associated with the Permian glacial deposits of the ancient southern continent of Gondwanaland, and has also been traced in the Permian of Russia.

Glottis is the aperture between the vocal cords in front and the arytenoid cartilages behind at the upper part of the trachea (wind-pipe). Its shape and extent are altered by the movements of the vocal cord and larynx, thus causing modulations of the voice (see *Larynx*).

Gloucester (glōs'tēr), a city, county of itself, parliamentary borough, and river port, England, capital of the county of same name, on the left bank of the Severn, here divided into two channels enclosing the Isle of Alney and crossed by two fine bridges, 33 miles north by east of Bristol, and 95 miles west by north of London. It carries on a considerable shipping trade, the Gloucester and Berkeley Canal giving access to the docks. The most remarkable public edifice is the cathedral; it was originally the church of a Benedictine abbey, dating from 1058, and was converted into a cathedral at the Reformation. It is cruciform, 444 feet in length, 154 feet in breadth, and 85½ feet in height, with a tower 230 feet high. It exhibits a great variety of styles, the choir, with its roof of fan-tracery, being a fine example of Perpendicular Gothic. Other buildings are several handsome old churches, the shire hall, the guildhall, the bishop's palace, and county schools of art and science. The schools include the collegiate school founded by Henry VIII, the theological college, the blue-coat school founded in 1666 (and now known as Sir Thomas

Rich's School), and the grammar-school of St. Mary de Crypt, founded in the time of Henry VIII. The industries are rather varied. Gloucester, which formerly returned two, now sends one member to Parliament. Pop. 51,330.

Gloucester, the county, is bounded by the Severn, Monmouth, Hereford, Worcester, Warwick, Oxford, Berks, Wilts, and Somerset; area, 805,842 acres, of which five-sixths are under crops and pasture. The county is naturally divided into three distinct districts, the Hill or Cotswold in the east; the Severn valley in the middle; and the Forest of Dean in the west. The principal rivers are the Severn, with its affluents the Wye, the Leden, and Lower and Upper Avon; and the Isis or Thames, with its affluents the Colne, Churnet, and Windrush. Iron and coal are found in the Forest of Dean, and the collieries employ a large number of hands. Coal is also found and extensively worked in the south part of the county; and lead ore is found in various parts. Limestone and freestone are also met with. Agriculture is in a flourishing state, especially in the vale districts of the county. Gloucester is, however, much more of a dairy than an agricultural county. The celebrated cheese known as double and single Gloucester is produced chiefly in the Vale of Berkeley. Orchards are numerous, from the produce of which large quantities of cider are made. Gloucester is a considerable manufacturing county, and has been long famous for its fine broadcloths. For parliamentary purposes the county is divided into four divisions, one member to each. Pop. 757,668.—Cf. W. Page, *Victoria County History*.

Gloucester, a town and port of Essex County, Massachusetts, near the extremity of Cape Ann, 28 miles N.N.E. of Boston. It is a popular summer resort; and fisheries and granite quarrying are the chief industries. About 2 miles distant is Norman's Woe, the scene of the wreck of the *Hesperus* celebrated by Longfellow. Pop. 22,947.

Glover, Richard, an English poet, born 1712, died 1785. Though engaged in trade, he devoted much of his attention to literature, and acquired a high reputation as a scholar and a poet. In 1760 he entered Parliament, where his abilities gained him considerable influence. He was the author of two epics, *Leonidas* and the *Atheniad*; *London, or the Progress of Commerce*; and three tragedies, *Boadicea*, *Medea*, and *Jason*. His *Diary* was published in 1813.

Glover, Terrot Reaveley, English scholar, was born in 1869. He was educated at Bristol Grammar School, and at St. John's College, Cambridge, and was appointed Public Orator at Cambridge in 1920. In 1924 he was President of the Baptist Union. His works include *Studies in Virgil*, *The Jesus of History*, and *Paul of Tarsus*.

Gloversville, a town, Fulton County, New York, 44 miles N.W. of Albany. Glove-making is the principal industry, hence the name of the place. Pop. 22,026.

Gloves are coverings for the hand, or for the hand and wrist, with a separate sheath for each finger. They are made of leather, fur, cloth, silk, linen thread, cotton, or worsted. The chief leathers used in glove manufacture are doe, buck, and calf-skins; sheep-skin for military gloves; lamb-skin for many of the so-called



Gloves

Left, Leather embroidered with silk, gold, and seed pearls (temp. Henry VIII). Right, Crimson velvet embroidered with gold and silver (temp. Queen Elizabeth).

kid gloves; true kid for the best and finest gloves; dog, rat, and kangaroo skins, &c. The leather in all cases undergoes a much lighter dressing than when used for boots and shoes. Leather gloves are usually cut out by means of dies, and sewed by a machine of peculiar construction. The best woollen, thread, and silk gloves are made by cutting and sewing, but commoner gloves are made by knitting and weaving. In England leather gloves are manufactured at London, Worcester, and elsewhere. Limerick was formerly celebrated for gloves of a peculiarly delicate kind. Gloversville, in New York, is the chief American seat of the manufacture. Italy, Belgium, Sweden, Denmark, and Germany all manufacture excellent gloves, but France supplies the world with most of the finer and more

expensive kinds. Large quantities of cotton gloves are manufactured at Nottingham and Leicester; and the greater number of woollen gloves is made in Wales, Scotland, and the north of England. Gloves are a very ancient article of dress, and many curious customs and usages are connected with them. They were worn by the ancient Greeks and the Romans. During the early Middle Ages they were considered as a sign of rank, and taken off in token of respect in churches and before a superior. They were afterwards often worn in the hat as ladies' favours. Throwing the glove down before a person amounted to a challenge to single combat. The use of gloves was introduced into England only in the thirteenth century. Queen Elizabeth set the fashion of richly-embroidered and bejewelled gloves. The judges in England used to be prohibited wearing gloves on the bench; and it was only in case of a maiden assize that the sheriffs were allowed to present a judge with a pair of gloves.—BIBLIOGRAPHY: S. W. Beck, *Gloves; their Annals and Associations*; W. M. Smith, *Gloves, Past and Present*; Côte, *L'Industrie gantière à Grenoble*.

Glow-worm, an insect of the genus *Lampyris* (*L. noctilūca*), of the ord. Coleoptera, or beetles, the name being strictly applicable only to the female, which is without wings, somewhat resembles a caterpillar, and emits a shining green light from the extremity of the abdomen. The male is winged, and flies about in the evening, when he is attracted by the light of the female, but is only faintly luminous himself, as also are eggs, larvæ, and pupæ. Decapitated specimens retain their power of giving out light for a considerable time. In pure oxygen, in warm water, or when crushed, the light of the luminous organs is increased in intensity. The larvæ are very voracious, living on snails, which they attack and kill. Belonging to the same family are the firefly and the railway beetle.

Gloxin'ia, a genus of plants, nat. ord. Gesneraceæ, distinguished by the corolla approaching to bell-shaped, the upper lip shortest and two-lobed, the lower three-lobed, with the middle lobe largest, and also by the summit of the style being rounded and hollowed. The species are natives of tropical America, whence they were introduced into Britain early in the eighteenth century. They are now among the greatest ornaments of European hothouses, owing to their richly-coloured leaves and their ample, graceful, delicately-tinted flowers. See *Sinningia*.

Gluchov, or **Gloukhov** (glō'hov), a town of the Ukraine, government of, and 148 miles east by north from Tchernigov. Pop. 14,856.

Glucium, commonly known as beryllium, is a rare metal having a specific gravity lower than aluminium, viz. 1.9; it is silver-white in colour

and resembles magnesium. It occurs in the minerals beryl, euclase, and gadolinite, and was named from its oxide, glucina, which was known long before the metal was isolated. The atomic weight is 9.1; it melts at 1800° F., and burns like magnesium when in the form of powder or ribbon.

Gluck (glūk), Christoph Willibald, Ritter von, German musical composer, born in Bavaria in 1714, died at Vienna 1787. When a boy he became a chorister, and acquired some skill on the harpsichord and organ. At eighteen years of age he went to Prague to enter the university, where he maintained himself by the exercise of his musical gifts. By degrees he attracted the attention of several Bohemian nobles, and Prince Lobkowitz assisted him when he went to Vienna



Gloxinias

to pursue his musical studies. The Lombardian Prince di Melzi then took him to Milan, where he studied under Giovanni Battista Sammartini, a famous organist and composer. In 1740 he was employed to compose an opera for the court theatre of Milan. The text chosen for him was the *Artaxerxes* of Metastasio, and the opera was a triumph, in spite of the innovations of style which the author introduced. In 1742 he wrote *Demofonte* for Milan; *Demetrio* and *Ipermestra* for Venice; in 1743 *Artamene* for Cremona, and *Siface* for Milan; in 1744 *Fedra* for the same theatre; and in 1745 *Alessandro nell' Indie* for Turin, all founded on classical subjects. Invited to London, he produced *La Caduta de' Giganti* (Fall of the Giants), which was not a success. In London Gluck became deeply impressed with the majestic character of Handel's airs and choruses, and with the simple but natural dramatic style of Dr. Arne. This visit to London, and a short trip to Paris, helped to develop that lyric genius which was destined to create a new order of musical composition. After producing many operas of the conventional type at Paris, Vienna, Rome, and Naples, he returned

to Vienna. The *Trionfo di Clelia* (1762) was the last of his operas in his first style. Pleased as the public was with his music, he was not satisfied. He felt himself continually cramped by the character of the libretti of Metastasio, who had hitherto furnished him with texts, which were rather lyrical dramatic poems than genuine dramas. The composer at last found a poet, in the person of Raniero Calzabigi, who sympathized with him in his ideas, and the result of their co-operation was the *Orfeo ed Euridice*, performed publicly for the first time in 1762. This opera marked a new era. The fame it acquired at once it never lost. Various works of lighter character filled up the interval between this year and 1766, when his second great opera of *Alceste* was produced, which raised public feeling to the point of enthusiasm. In his dedication of this work to the Grand-Duke Leopold of Tuscany he enunciates the principles of the new school, which shortly were that the opera should be a musical drama, not a concert in costume; that the text must be descriptive of real passion; that the music must voice fully the spirit of the text; that in accompaniments the instruments must be used to strengthen the expression of the vocal parts by their peculiar characters, or to heighten the general dramatic effect by employing them in contrast to the voice. Gluck now became convinced that his system must be tested on a wider field, and believed that the Royal Opera in Paris offered all a composer could demand. A Frenchman of culture and genius, Bailly du Rollet, adapted Racine's *Iphigénie en Aulide* for musical treatment, and after a considerable amount of opposition from the musical critics of the old Italian and French school, at that time represented in Paris by Piccini, the piece was brought out in 1774. The intensest excitement prevailed; all Paris took sides, and for a long time the Gluckists and Piccinists contended with much bitterness, but ultimately the victory remained with the Gluckists. Shortly after the production of the *Iphigénie*, the *Orfeo* was adapted for and put on the French stage, and was followed by the *Armide* in 1777, by the *Iphigénie en Tauride* in 1779, Gluck's last important work, and by many considered his greatest. It ends the series of works which gave a direction to the operatic genius of Méhul and Cherubini in France, and of Mozart and Beethoven in Germany.—BIBLIOGRAPHY: A. Reissmann, *Christoph Willibald von Gluck*; E. Newman, *Gluck and the Opera*; J. d'Udine, *Gluck, biographie critique*.

Glucose, also known as dextrose or grape sugar, is a carbohydrate of the formula $\text{CH}_2(\text{OH}) \cdot (\text{CHOH})_4 \cdot \text{CHO}$, occurring naturally in honey, grapes, and other fruit. It is also present in the urine of persons suffering from *diabetes*

mellitus; in chronic cases as much as 1 lb. of glucose may be excreted *per diem*.

Glucose has been synthetically prepared from its elements by a complicated series of reactions, but on a commercial scale it is manufactured by boiling starch with dilute sulphuric acid. As a source of starch, potatoes, maize, rice, or sago are used. The degree of concentration of the solutions is of great importance; in practice 1.5 parts of starch in the form of a thick solution are added with stirring to about 2 parts of 2 per cent sulphuric acid, the mixture being kept boiling by means of steam. The starch is converted firstly into dextrine (British gum) and maltose (malt sugar), and finally, on prolonged boiling, into glucose. The acid is then neutralized with chalk or limestone, the solution of glucose filtered from the precipitated matter, and evaporated to a thin syrup. After decolorizing with bone charcoal the syrup is evaporated further in vacuo and allowed to crystallize. The process of solidification can be hastened by adding a small quantity of pure glucose, the mass being stirred continuously.

Pure glucose forms a colourless crystalline mass, less sweet than cane sugar, melting at 86°C ., and losing its one molecule of water of crystallization at 110°C . It is very soluble in water but only sparingly so in alcohol. It is distinguished from cane sugar by the fact that it is not charred by warm sulphuric acid. Its solution rotates the plane of polarized light to the right (*dextro-rotatory*). It is readily fermented by yeast, giving alcohol and carbonic acid gas, and is consequently largely used in brewing. Chemically it behaves as a polyhydric alcohol and also as an aldehyde, which accounts for its strong reducing properties. Thus a solution of glucose readily reduces a warm alkaline solution of cupric tartrate (Fehling's solution), red cuprous oxide being quantitatively precipitated. This test is employed in estimating the amount of glucose in solutions, notably in the case of diabetic urine.

Glucose is also formed, together with an equal quantity of fructose, when cane sugar is boiled with dilute acids. This mixture, known as invert sugar, forms a colourless syrup sweeter than cane sugar and is largely used in the manufacture of champagne, liqueurs, fruit preserves, and honey substitutes.

Glu'cosides, a group of carbon compounds (including amygdalin, salicin, &c.) occurring in the vegetable kingdom, and characterized by the fact that on hydrolysis or saponification with dilute acids a sugar, usually glucose, is formed along with other products.

Glue (O.Fr. *glu*, bird-lime) consists of a sticky gelatinous material obtained from the cartilaginous substance of hides, bones, fish skins, &c.:

from which it is prepared by prolonged boiling with water, a process which gradually dissolves the glue-forming tissue.

Leather Glue or Skin Glue.—The best-quality brown glues are obtained from hides, but the skins of sheep and other animals are largely used in the preparation of good-quality light-coloured glues. The raw material, which is generally in the form of cuttings from tanneries and slaughter-houses must be quite fresh. After washing, it is soaked in milk of lime for two or three weeks. The swollen gelatinous substance is then treated with soft water or a dilute solution of sulphurous acid to remove the last trace of lime, as otherwise an inferior product would be obtained. This substance is then 'melted' by boiling with a small quantity of water in an open vessel or by means of steam alone. The lower the temperature employed the better the resulting glue; for this reason vacuum apparatus is often used. The liquid obtained is purified by standing and filtering, and if necessary decolorized by animal charcoal. The purified glue solution is then run into moulds and allowed to cool to a firm jelly which is cut into pieces of a convenient size by a wire or wet knife, and dried in the open air on netting stretched over frames. During the drying process the cakes must be carefully watched, as during warm moist weather the glue readily undergoes decomposition and is spoilt. The final drying is usually carried out in a warm well-ventilated room. To give the cakes a bright appearance they are dipped in water and again dried.

Bone Glue.—This type of glue, though not such a strong adhesive as hide glue, is largely prepared in connection with the manufacture of bone meal and phosphorus. The raw bones are crushed, freed from oily matter, and decalcified by treatment with dilute hydrochloric or sulphurous acid; the remaining translucent cartilage is then treated with lime, well washed and finally boiled down to form glue as in the case of leather glue.

Fish Glue is prepared from the skins of fish, the heads and bones of cod, and also from whale blubber when freed from oil, by a method similar to that used for bone glue. If the boiling is carried out correctly, fish glue is a viscous liquid when cold, and forms a very tenacious adhesive. The best kind of fish glue is isinglass, which consists of the purified and dried inner skin of the swim-bladder of the sturgeon.

Marine Glue consists of a solution of india-rubber in turpentine, to which is added powdered asphalt or shellac. It is an extremely powerful adhesive and must be applied hot.

Glume, in botany, the imbricate scale-like bract inserted on the axis of the spikelet in Gramineæ (grasses) and Cyperaceæ (sedges).

Gluten, a tough elastic substance of a greyish colour, which becomes brown and brittle by drying, found in the flour of wheat and other grain. Being a mixture of proteins, it contributes much to the nutritive quality of flour, and gives tenacity to its paste. A similar substance is found in the juices of certain plants.

Glutton, the *Gulo luscus*, a carnivorous quadruped, about the size of a large badger, and belonging to the weasel family (Mustelidæ). It inhabits Northern Europe and America, and is known also by the name of *Wolverene* or *Wolverine*. The glutton is slow and deficient in agility, but persevering, cunning, fierce, and of great strength. It prefers putrid flesh, and has



Glutton (*Gulo luscus*)

an extremely fetid odour. The fur is valuable, that from Siberia being preferred from its being a glossy black. The animal receives its name from its voracity, which, however, has been greatly exaggerated.

Glycerine, or **Glycerol** (*glycys* = sweet, *kēros* = wax), is a trihydric alcohol which does not occur naturally in the free state, but always in combination with fatty acids as the essential constituent of fats and oils of animal or vegetable origin. It is obtained as a by-product in the manufacture of soap and candles from these fats. Chemically it is a trihydroxy-propane of the formula $\text{CH}_2\text{OH}\cdot\text{CHOH}\cdot\text{CH}_2\text{OH}$. It was discovered by Scheele in 1779, and has been prepared synthetically from its elements. The principal sources of glycerine are stearin, the main constituent of mutton fat; palmitin, present in palm oil and other oils; and olein, which is found in the soft fats such as lard.

The hydrolysis ('saponification') of the fat is carried out by boiling with caustic soda solution; the soap (the sodium salt of the fatty acid) is then salted out. The residual lye con-

tains practically all the glycerine present in the original fat. This lye is filtered, evaporated, and finally distilled with superheated steam. The distilled glycerine solution is then decolorized with animal charcoal, and concentrated under reduced pressure. The purest form of glycerine is obtained in the preparation of fatty acids for candle-making by heating fats under pressure with water alone, or with the addition of a small quantity of lime, magnesia, or sulphuric acid. The liquor produced is distilled and finally concentrated in vacuo.

During the European War a new process for the manufacture of glycerine without the use of fats was carried out successfully in Germany. The process is based on the fact that when sugar is fermented by yeast, a large proportion of glycerine is formed if certain substances of an alkaline nature are present. Thus, if the fermentation is carried out with a quantity of sodium sulphite equal to that of the sugar used, together with a quantity of alcohol and other products. After removing the yeast by filtration and the alcohol by distillation, the residual liquor is neutralized and finally distilled with superheated steam.

The yield of glycerine is said to be independent of the type of yeast, the nature of the sugar, and the temperature at which the fermentation is carried out. Raw sugar or even molasses may be used in the process.

Pure glycerine is a colourless viscid liquid with a sweet taste, having a specific gravity of 1.265. It absorbs moisture and when exposed to a low temperature crystallizes to a solid which melts at 20° C. It boils at 290° C. with partial decomposition, but may be distilled under reduced pressure without change. On rapid heating it loses water with the formation of acrolein vapours, which have a pungent odour.

Glycerine is used in enormous quantities for the manufacture of explosives such as dynamite and cordite, both of which contain nitroglycerine. It is also largely used in dyeing, calico-printing, and in the manufacture of leather. Medicinally it is applied externally as a remedy for chapped hands, and internally as a demulcent, and in the form of a suppository as a means of relieving constipation. A mixture of glycerine and water is used as a filling for gas meters as it remains liquid at low temperatures.

Glycogen, the principal carbohydrate in Fungi, where it takes the place of starch; also found in the Bacteria and in the liver of many animals.

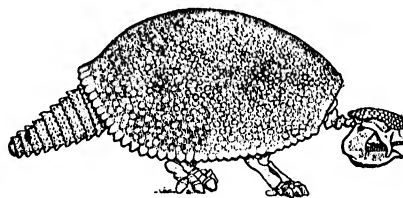
Glycol, a generic name applied to all dihydric alcohols, that is, to alcohols which contain two hydroxyl groups in the molecule. These glycols are intermediate between ethyl alcohol and

glycerine. The simplest representative is ethylene glycol, $C_2H_4(OH)_2$, usually known as glycol. It is liquid, inodorous, of a sweetish taste, and dissolves readily in water and alcohol.

Glycyrrhiza (gli-si-rī'za), a genus of leguminous plants, of which *G. glabra*, the liquorice plant, is the type.

Glyptodon (Gr. *glyptos*, engraved, and *odous*, tooth—so named from its fluted teeth), a gigantic fossil edentate animal, closely allied to the armadillos, found in the Upper Tertiary and the Quaternary strata of South America. It was of the size of an ox, and was protected by a rigid coat of mail formed of polygonal osseous plates united by sutures.

Gmünd (gmünt), a town of Württemberg, on the Rems, 28 miles E.N.E. of Stuttgart, formerly an imperial free city. It has three churches of great antiquity, and an extensive museum of



Glyptodon clavipes from the Pampa formation of Buenos Ayres

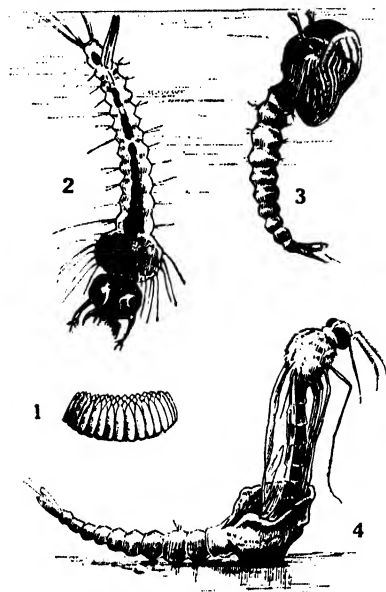
industrial products. The manufactures are chiefly woollen and cotton goods, jewellery, and trinkets. Pop. 20,294.

Gmunden (gmün'den), a town of Upper Austria, situated among magnificent scenery, on the Traun, where it issues from the northern extremity of the lake of that name, 35 miles south-west of Linz. Most of the inhabitants are employed in the neighbouring salt-mines. Gmunden is a favourite health-resort and summer residence. Pop. 7190.

Gnaphalium, a genus of widely-spread composite plants having their foliage usually covered with a white woolly down, and their flower-heads of the 'everlasting' kind, some of them natives of Britain. *G. Leontopodium* (*Leontopodium alpinum*) is the *edelweiss* of the Alps.

Gnat, the name applied to several species of insects belonging to Culex and related genera. The name is also given to the much smaller *midges* (q.v.). The common gnat (*C. pipiens*), type of the sub-family Culicidæ, is of wide geographical distribution, and is noted for its power of inflicting irritating wounds. The proboscis of the female is a tube containing four spiculæ of exquisite fineness, dentated or edged; these are modified mandibles and maxillæ. The males do not bite, and are further distinguished by their plume-like antennæ. These insects

also feed on the juice of plants. The female deposits her eggs on the surface of stagnant water in a long mass. After having remained in the larval state for about twenty days, they are transformed into chrysalids, in which all the limbs of the perfect insect are distinguishable through the diaphanous robe with which they are then shrouded. After remaining three or four days wrapped up in this manner, they be-



Gnat (*Culex pipiens*)

1 Egg-raft. 2, Larva. 3, Pupa. 4, Perfect insect emerging from pupa skin.

come perfect insects. *Mosquitoes* (q.v.) are closely allied.

Gneisenau (gni'zn-ou), August Wilhelm Anton, Count Neithardt von, Prussian general, born 1760, died 1831. He served with the German auxiliaries of England in America; and as chief of Blücher's staff chiefly directed the strategy of the Prussian army at Waterloo. He was made a field-marshal in 1825.

Gneiss (nis), a species of rock, composed of quartz, felspar, and mica, with a foliated or banded structure. The layers are often crumpled. Gneiss passes on one side into granite, from which it differs in its foliated structure, and on the other into mica-schist. It contains no fossil remains. Porphyritic gneiss presents large distinct crystals of felspar round which the foliated layers have flowed. Some gneisses have resulted from the crushing of crystalline rocks and the flow of the mass under pressure; others from flow in igneous masses; others from the intrusion of

granite, in parallel sheets, along the foliation-planes of schists. Gneiss is the principal rock of very extensive districts; it predominates in Norway, and all the north of Europe. It abounds in the Southern Alps and the Pyrenees, and forms extensive areas in Central and Southern Africa. In Canada and the Northern United States gneiss is common, especially in the 'Laurentian Plateau' and the region of the Great Lakes.

Gneist (gnîst), Heinrich Rudolf Hermann Friedrich, German jurist, born at Berlin 1816, died in 1895. He studied at the university of his native town, in which, in 1844, he became professor-extraordinary, and in 1858 ordinary professor. He took part in politics as a member of the Prussian House of Deputies, and of the Diet of the German Empire, ranging himself on the Liberal side. He wrote extensively on law and constitutional history, and had a specially thorough knowledge of English constitutional history, his works on the *English Constitution* and the *English Parliament* having been translated and published in England in 1886.

Gnesen (gnä'zn), a town of Poland, formerly in Prussia, province of Posen, 45 miles southwest of Bromberg. It is an ancient place; is the see of an archbishop, and has a cathedral, in which the Kings of Poland used to be crowned. Pop. 25,339.

Gnetales, a small and peculiar family of Gymnosperms, approaching the Angiosperms in certain features. Genera: *Ephedra*, *Gnetum*, *Welwitschia* (q.v.).

Gnetum, the type-genus of Gnetales, comprising tropical climbing or erect shrubs or small trees, with broad leathery, net-veined leaves. The fleshy 'fruits' of *G. Gnomon* and other species are edible.

Gnome (nôm; Gr. *gnōmē*), a short, pithy saying, often expressed in figurative language, containing a reflection, a practical observation, or a moral maxim. Among the Greeks Theognis, Phocylides, and others are called the *Gnomic poets*, from their sententious manner of writing.

Gnome (nôm), in the cabalistic and mediæval mythology, the name given to the spirits which dwell in the interior of the earth, where they watch over mines, quarries, and hidden treasures. They assume a variety of forms, but are generally grotesque dwarfs, ugliness being their appropriate quality. The term *gnome* has often been used as an equivalent of *fairy* or *elf*.

Gnomon (nō'mon), the style of a dial, or a structure erected perpendicularly to the horizon, for the purpose of determining the positions of heavenly bodies, particularly of the sun, by means of the direction and length of the shadow it casts. The gnomon often takes the form of a pillar, column, or pyramid erected upon level

ground. It was much used by the ancient astronomers, and gnomons of great height, with meridian lines attached to them, are still common in France and Italy.

Gnosticism, a general term applied to the theories of certain early schools of speculators, which combined the fantastic notions of the Oriental systems of religion with the ideas of the Greek philosophers and the doctrines of Christianity. They nearly all agreed on the points that God is incomprehensible; that matter is eternal and antagonistic to God; that creation is the work of the *Demiurge*, an emanation from the Supreme Deity, subordinate or opposed to God; and that the human nature of Christ was a mere deceptive appearance. Gnosticism is the result of a fusion of diverse beliefs, and it covers a wide variety of religious thinking. Certain forms of Gnosticism are mere adaptations of the Persian dualism to the solution of the problem of good and evil; while the pantheism of India seems to have been a pervading influence in others. Simon the magician (Simon Magus) of whom Luke speaks in the *Acts of the Apostles*, is generally looked on as the first of the Gnostics. The dogmas of the earliest Gnostics may be reduced to the following heads: God, the highest intelligence, dwells at an infinite distance from this world, in the Abyss, removed from all connection with every work of temporal creation. He is the source of all good; matter, the crude, chaotic mass of which all things were made, is, like God, eternal, and is the source of all evil. From these two principles, before time commenced, emanated beings called *æons*, which are described as divine spirits, inhabiting the Plerōma, or plenitude of light, which surrounds the Abyss. The world and the human race were created out of matter by one æon, the Demiurge, or, according to the later systems of the Gnostics, by several æons and angels. The æons made the bodies and the sensual soul of man of this matter; hence the origin of evil in man. God gave man the rational soul; hence the constant struggle of reason with sense. What are called gods by men (for instance, Jehovah, the God of the Jews) are merely such æons or creators, under whose dominion man became more and more wicked and miserable. To destroy the power of these creators, and to free man from the power of matter, God sent the most exalted of all æons, to which character Simon first made pretensions. The Nicolaitans mentioned in the *Revelation of St. John*, so called from Nicolas, a deacon of the Church at Jerusalem, were one of the earliest sects, and are described as forerunners of the Cerinthians. Cerinthus, a Jew, of whom John the Evangelist seems to have had some knowledge, combined such reveries with the doctrines of Christianity,

and maintained that the most elevated æon sent by God for the salvation of man was Christ, who had descended upon Jesus, a Jew, in the form of a dove, and through him revealed the doctrines of Christianity, but before the crucifixion of Jesus separated from him, and at the resurrection of the dead will again be united with him, and lay the foundation of a kingdom of the most perfect earthly felicity, to continue 1000 years. Carpocrates and the sect of the Ophites (beginning of the second century), to whom the term Gnostic was first applied, saw in the Serpent a wise and good being, and carried to its extreme form the inversion of the Biblical story. The later Gnostics have been divided into three schools. The first was the Syrian, founded by Menander, a pupil of Simon. This school emphasizes the conflict between Good and Evil—the Supreme Deity on the one hand, and the Demiurge and his angels or æons on the other. The second was the school of Alexandria, represented by Basilides and Valentinus; the system of the latter being the most complete and ingenious of all. In that light or plenitude, which all the Gnostics speak of as surrounding the residence of the Supreme God, he has placed fifteen male and as many female æons. The Supreme God, the Unbegotten, the Original Father, whom he also calls the *Deep* (Bathos), is the first of these æons; Thinking Silence was his wife, and Intelligence, a male, and Truth, a female, were their children. These produced The Word and Life, the latter a female, who gave birth to mankind and society. These eight constituted the first class of the thirty æons. The second class, of five couples, at the end of which stood the Only Begotten, and the third, of six couples, at the head of which stood the Comforter, were, in a similar manner, descended from Mankind and Society, and consisted, like the first, of personified ideas. The officers of this heavenly state are four male æons—Horus, who guards the boundaries of the region of light; Christ and the Holy Ghost, who instruct the other æons in their duties; and Jesus, whom all the æons of the kingdom of light begat in common, and endowed with their gifts. Man and the world were formed by a demiurge out of matter which was partly material, partly spiritual, partly soul-like. Christ, the Saviour of men, when he appeared on earth had a visible body made of the spiritual and the soul-like substance only. At his baptism the æon Jesus united itself with him, and instructed mankind. A third school of Gnosticism, whose centre was Asia Minor, was represented by Marcion of Pontus, the son of a Christian bishop, who flourished about the middle of the second century. Marcion assigned to Christianity, as the one absolutely independent religion, a complete

isolation from the Old Testament revelation, the author of which was, in his opinion, merely a just but not a good being. The true God begat many spirits, among which were the creator of the world, the righteous God, and the lawgiver of the Jews. The last, through the prophets, promised Christ; but Jesus, who actually appeared, and is the true Redeemer, was the Son of the truly good God, and not the Jewish Messiah. Towards the end of the second century Tatian, a Syrian Christian, adopted Gnostic doctrines, and founded a sect. Bardesanes, a Syrian, and Hermogenes, an African, who, in the reign of the Emperor Commodus, apostatized from Christianity, and established sects, bordered, in their hypotheses concerning the origin of good and evil, upon Gnosticism. There have been no Gnostic sects since the fifth century; but many of the principles of their system of emanations reappear in later philosophical systems, drawn from the same sources as theirs.—BIBLIOGRAPHY: C. W. King, *The Gnostics and their Remains*; H. L. Mansel, *The Gnostic Heresies of the First and Second Centuries*; G. R. S. Mead, *Fragments of a Faith Forgotten*; F. Swiney, *Esoteric Teachings of the Gnostics*; E. de Faye, *Introduction à l'étude du gnosticisme*; J. Watson, *The Philosophical Basis of Religion*.

Gnu, the *Wildebeeste* ('wild beast') of the colonists, the name given to three species of

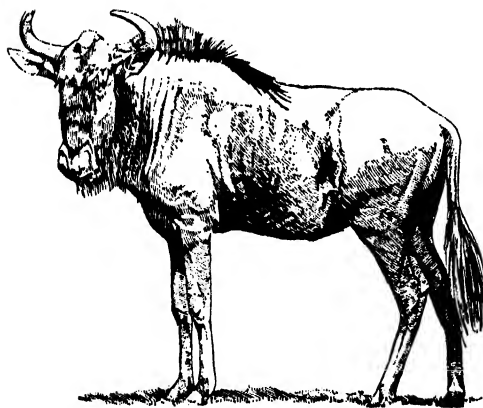
9 feet, and stand about 4 feet high at the shoulder. They live in herds; are said to be fierce when attacked, but when taken young have been found to be capable of domestication. The blue or brindled gnu (*C. taurinus*) is larger than the common gnu, has black stripes on the neck and shoulders, and a black tail. Gnus wheel in a circle once or twice before setting off when alarmed.

Goa, a city in Hindustan, on the Malabar coast, capital of the Portuguese colony of the same name. The name is applied to two distinct places, namely, Old Goa, and New Goa or Panjim. The former was once the chief emporium of commerce between the East and West, and had a population of 200,000, but it is now nearly deserted, though some pains are taken to keep the ancient churches and convents in repair. Pop. 2302. New Goa or Panjim was chosen as the residence of the Portuguese viceroy in 1759; and in 1843 it was made the capital of Portuguese India. It is situated on the left bank of the Mandavi, about 3 miles from its mouth, contains many fine public buildings, a cathedral, and a viceregal palace. The trade of Goa, at one time the most extensive of any place in India, is now inconsiderable. Pop. 9325. The colony around Goa belonging to the Portuguese has an area of 1469 sq. miles. It is well watered and fertile. About two-thirds of the total population, numbering 515,772, are the descendants of Hindus converted to Christianity on the subjugation of the country by the Portuguese.

Goalpa'ra, a district of British India, in Assam; area, 3897 sq. miles; pop. 462,000. It lies on both sides of the Brahmaputra, and is exposed to river floods. Rice is the staple crop; and brass and iron utensils, and gold and silver ornaments of an artistic character are manufactured. The town of Goalpara is the chief centre of trade. Pop. 5400.

Goa Powder, a powder used in the treatment of certain skin diseases, obtained from a leguminous tree of South America, the *Andira Araroba*, and called also Araroba Powder. See *Andira*.

Goat, a well-known horned ruminant quadruped of the genus *Capra*. The horns are hollow, erect, turned backward, annular on the surface, and scabrous. The male is generally bearded under the chin. Goats are nearly of the size of sheep, but stronger, less timid, and more agile. They frequent rocks and mountains, and subsist on scanty coarse food. Their milk is sweet, nourishing, and medicinal, and their flesh furnishes food. There is a large number of varieties of goats, and it is not certainly known from which the domestic goat is descended, though opinion favours the *C. agagrus*, or wild goat of Western Asia. Goats are generally subdivided



Brindled Gnu (*Connochætes taurinus*)

South African antelope (*Connochætes gnu*, *C. taurinus*, and *C. albogulatus*). The first, known as the common or white-tailed gnu, is now rarely found south of the Vaal; its form partakes of that of the antelope, ox, or horse. Both sexes have horns projecting slightly outwards and downwards, then forming an abrupt upward bend. They have bristly black hair about the face and muzzle, a white stiff mane, and horse-like tail. They attain a length of about

into ibexes and goats proper. They are found in all parts of the world, and many varieties are valued for their hair or wool. The skin is prepared for a variety of purposes, and yields the leather well known under the name of *morocco*. The Kashmir goat, as its name indicates, is a native of Kashmir; it is smaller than the



Angora Goat (*Capra hircus angorensis*)

common domestic goat, and has long, silky, fine hair. The Angora goat is also furnished with soft silky hair of a silver-white colour, hanging down in curling locks 8 or 9 inches long. Its horns are in a spiral form, and extend laterally. The Rocky Mountain goat is the *Haplocærus montānus*, or big-horn (q.v.).—BIBLIOGRAPHY: R. Lydekker, *Wild Oxen, Sheep, and Goats*; H. S. H. Pegler, *The Book of the Goat*.

Goat Island, a small island of 70 acres, which divides the current of the Niagara River at the Falls. It is connected with the American shore by a bridge.

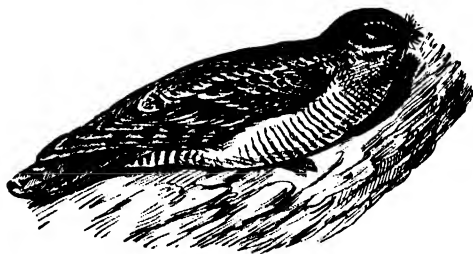
Goat-moth, a large British moth (*Cossus ligniperda*). The larvæ, which are about 3 inches in length, hollow out galleries in the wood of trees, which they first soften by a strong-smelling juice which they secrete. With the sawdust made in the operation they form cocoons, in which the chrysalids are developed. The larval condition lasts for three years. The fully-developed insect is ash-coloured, with numerous small black lines on the first pair of wings.

Goat's-beard, the general name of plants of the genus *Tragopogon*, ord. Compositæ, herbaceous perennials, chiefly natives of Europe. The fruits have feathery appendages; hence the name. The yellow goat's-beard (*T. pratensis*), greater goat's-beard (*T. major*), and purple goat's-beard (*T. porrifolius*) are found in Britain. The last species is commonly cultivated for its root as a culinary vegetable, under the title of *salsify*.

Goat's-rue (*Galëga officinālis*), a leguminous plant indigenous to the south of Europe. It is used as forage, and is supposed to increase the milk of cows that feed upon it. It was formerly in repute as a cordial for fevers and convulsions.

Goat's-thorn, a name given to two hardy evergreen plants of the genus *Astragalus*, *A. Tragacantha* (great goat's-thorn), and *A. Poterium* (small goat's-thorn). The former, long cultivated in Great Britain, is a native of the south of Europe, the latter of the Levant.

Goatsucker, a name common to the birds of the genus *Caprimulgus*, as also to all belonging to the same family—the *Caprimulgidae*, given originally from the erroneous opinion that they suck goats. The European goatsucker or fern-owl (*C. europæus*) is one of our summer visitors, and ranges into Asia and Africa. It feeds upon nocturnal insects, as moths, gnats, beetles, &c., which it catches on the wing, flying with its mouth open. Its mouth is comparatively large, and lined on the inside with a glutinous substance to prevent the escape of those insects which fly into it. As in all birds which catch flies when on the wing, the gape is surrounded by stiff bristles. When perched, it usually sits lengthwise on a bare twig, with its head lower than its tail, and in this attitude utters a jarring note, whence one of its common names—*night-jar* or *night-churr*. It is about 10 inches long, and has a light, soft plumage, minutely mottled with grey and brown, which renders it very inconspicuous when perching on a branch. The



Goatsucker (*Caprimulgus europæus*)

American chuckwill's widow, whip-poor-will, and night-hawk belong to the same family.

Gobelins (gob-lan) Manufactory, a tapestry manufactory at Paris, established by Colbert in 1667, on the site of a previously existing manufactory which had been set up by Jehan Gobel, a celebrated dyer in the reign of Francis I. Colbert collected into it the ablest workmen in the divers arts and manufactures connected with house decoration and upholstery, and employed the artists Lebrun and Vouet as designers. The Gobelins, closed during the Revolution, has continued since the restoration of the Bourbons to

be the first manufactory of the kind in the world. Many celebrated paintings of the old Italian, French, and Spanish schools have, in the most ingenious manner, been transferred to tapestry.—Cf. J. J. Guiffrey, *Histoire de la tapisserie en France*.

Gobi, Desert of, the Shamo or 'sand-sea' of the Chinese, an immense tract of desert country, occupying the central part of the high tableland of Eastern Asia, and extending over a large portion of the Chinese territory of Mongolia. Its length is probably about 1500 miles; mean breadth, between 350 and 400 miles; area, about 300,000 sq. miles. Its general elevation is over 4000 feet above sea-level. The East Gobi is occupied by different tribes of the Mongolian race, who have numerous herds of camels, horses, and sheep. In the West Gobi are some nomadic tribes of the Tartar race. This tract is supposed at one time to have been a great inland sea.

Goby, the general name of a family of spiny-finned fishes (Gobiidae) characterized as follows: Two dorsal fins nearly united into one, the anterior fin having flexible rays, not spinous, as is usual in the group; ventral fins thoracic, and united more or less by their bases; body scaly, the head unarmed. Like the blennies they can live for some time out of water. The family is very numerous, about 600 species being known, but does not include any important food-fishes. Several species of the type-genus *Gobius* are common on the British coast. The male constructs a sort of nest and jealously guards the developing eggs.

God'alming, a municipal borough of England, in Surrey, 4 miles s.s.w. of Guildford, on the River Wey, which is navigable from this point, in a most picturesque district. There are tanneries, paper-mills, &c. Pop. 9193. On an elevated plateau to the north stands the Charterhouse School, removed here from London in 1872.

Godavari, a large river of Central India, which rises about 50 miles from the shore of the Indian Ocean, flows across the Deccan from the Western to the Eastern Ghâts in a general south-easterly direction, and being joined by several affluents, falls by three principal mouths into the Bay of Bengal, after a course of 900 miles. Before the river divides there are three great obstacles to navigation, caused by three rocky barriers. The Godavari is one of the twelve sacred rivers of India, its rivals being the Ganges and the Nerbada. Bathing in its waters washes away all sins.—*Godavari* is also the name of a British district of the Madras Presidency; area, 7972 sq. miles; pop. 2,078,782. Coringa and Coconada are its chief ports.

Goderich, a port in Ontario, Canada, on Lake Huron, 55 miles n.n.w. of London; with

manufactures of iron-castings and machinery, salt-refineries, fisheries, and large shipping trade. Pop. 4522.

Godesberg (go'des-berh), a village and health-resort in the Rhineland, Germany, in a magnificent position on the left bank of the Rhine, 5½ miles south-east of Bonn, nearly opposite 'the castled crag of Drachenfels'. It has its own ruined castle, dating from 1213, and has every year thousands of visitors, who go there to take the waters. Pop. 10,644.

Godetia, a genus of Onagraceæ, natives of Western America. Several hardy species are grown for their showy flowers.

Godfrey, Sir Edmund Berry (Sir Edmund-bury), the magistrate who received the depositions of Titus Oates with regard to the alleged Popish Plot, 28th Sept., 1678. He was soon after found dead, pierced with his own sword, though evidently not by his own hand. His death was imputed to the resentment of the Papists, and the excitement aroused was the actual cause of the Popish Plot agitation.—Cf. J. Pollock, *The Popish Plot*.

Godfrey of Bouillon, leader of the first Crusade, son of Eustace II, Count of Boulogne, born near Nivelles 1061, died at Jerusalem 1100. He distinguished himself while fighting for the Emperor Henry IV in Germany and Italy, and was made Duke of Bouillon. In order to expiate his sin of fighting against the Pope, he took the cross for the Holy Land in 1095, and led 80,000 men to the East by way of Constantinople. On the 1st of May, 1097, they crossed the Bosphorus, and began their march on Nice (Niçea), which they took in June. In July the way to Syria was opened by the victory of Dorylæum (Eski Shehr), in Phrygia, and before the end of 1097 the Crusaders encamped before Antioch. The town of Antioch fell into their hands in 1098, and in the following year Godfrey took Jerusalem itself, after a five weeks' siege. The leaders of the army elected him king of the city and the territory; but Godfrey would not wear a crown in the place where Christ was crowned with thorns; and contented himself with the title of *duke and guardian of the holy sepulchre*. The defeat of the Egyptians at Ascalon placed him in possession of all the Holy Land, excepting two or three places. Godfrey now turned his attention to the organization of his newly-established Government, and promulgated a code of feudal laws called the *Assize of Jerusalem*. Godfrey was a favourite subject of mediæval poetry, and is the central figure of Tasso's *Jerusalem Delivered*.—Cf. Hagenmeyer, *Gesta Francorum*.

Godi'va, the wife of Leofric, Earl of Mercia and Lord of Coventry in the reign of Edward the Confessor, heroine of a celebrated tradition.

In 1040 Godiva appealed to her husband to relieve the inhabitants of Coventry of certain exactions imposed on them. Leofric, however, only laughed at her, and when she persisted in her entreaties at last said to her, half jocularly, that he would grant her request if she would ride naked through the town of Coventry. Godiva took her husband at his word, proclaimed that on a certain day no one should leave his house before noon, that all windows and other apertures in the houses should be closed, and that no one should even look out until noon was past. She then mounted naked on her palfrey, rode through the town, and returned; and Leofric, in fulfilment of his promise, freed the inhabitants from the burdens he had imposed on them. Only one person, 'Peeping Tom', the story says, attempted to look out, and he was immediately struck blind. A yearly pageant, in which a young woman enacted the part of Godiva, was long kept up at Coventry, and still occasionally takes place. Tennyson's poem on *Godiva* is well known.—Cf. M. D. Harris, *Story of Coventry*.

Godolphin, Sidney, Earl of Godolphin, English politician, was a native of Cornwall, date of birth unknown, probably 1645. Under Charles II, he was one of those who voted for the exclusion of the Duke of York from the throne in 1680. He nevertheless retained office under that monarch, as he did also under William III, with whom he had long been in correspondence. During the reign of Anne he was appointed Lord High Treasurer of England, and in this office did much to improve the public credit, and check corruption in the administration of the public funds. In 1706 he was made Earl of Godolphin, and four years afterwards was obliged to retire from office. His death took place in 1712. He was a man of great business capacity, but his treasonable correspondence with James while he held an office of trust under William of Orange is a serious blot upon his character.—BIBLIOGRAPHY: Evelyn, *Diary*; H. Elliot, *Life of Sidney, Earl of Godolphin*.

Godoy, Manuel, Duke of El Alcudia, better known as the *Prince of the Peace*, was born at Badajoz 1767, died 1851. He entered the royal body-guard in 1787. His personal qualities soon made him a favourite at the Spanish court, and his promotion was rapid. In 1791 he became adjutant-general of the guards, in 1792 lieutenant-general, Duke of El Alcudia, grandee of Spain of the first class, and Prime Minister; and in 1795, as a reward for the part he had taken in concluding peace with France, he was presented with a large and valuable landed estate, and made a knight of the Golden Fleece. It was on this occasion also that he was named by the king Prince of the Peace. As he used his vast

power in the promotion of French more than Spanish interests, he became extremely unpopular, and the hatred of the people became so great in 1808 that he had to take refuge in France. Having lost everything, he lived for a long time only on the bounty of his royal friends. In 1847 he was permitted to return to Spain and resume his titles. The larger portion of his domains, however, was irrecoverably lost, and he ended his days in obscurity and poverty.—Cf. E. d'Auvergne, *Godoy, the Queen's Favourite*.

God save the King (or Queen), the burden and common appellation of a well-known English national song. Concerning the author and the composer opinions differ. It has been attributed to Dr. John Bull (1562-1628), chamber musician to James I; his ode, dating from the Gunpowder Plot, beginning "God save great James our King". But the composition we now possess would seem to have been, both words and melody, the work of Henry Carey (died 1743). It appears to have been first published, together with the air, in *Harmonia Anglicana* (1742), and in the *Gentleman's Magazine* in 1745, when the landing of the young Stuart called forth expressions of loyalty from the adherents of the reigning family. After Dr. Arne, the composer of another national song (*Rule, Britannia!*), had brought it on the stage, it soon became very popular. Since that time the harmony of the song has undoubtedly been improved, but the rhythm is the same as it was originally.—BIBLIOGRAPHY: article in Grove's *Dictionary of Music and Musicians*; W. H. Cummings, *God Save the King*.

Godwin, Earl of Wessex, an English statesman, born about 990; died 1052. In 1018 he was created an earl by Canute, and married the king's niece Gytha. During the reign of Edward the Confessor, who married Godwin's daughter, a quarrel arose between Godwin and the king, occasioned by the partiality of Edward for Norman favourites, and Godwin was compelled to quit the kingdom. In 1052, however, he returned with an army, forced Edward to enter into negotiations with him, re-established himself triumphantly in his old supremacy, and caused the expulsion from the kingdom of most of the Norman intruders. He was the father of King Harold, who was afterwards killed at Hastings (1066).

Godwin, Mary, also well known by her maiden name of Wollstonecraft, born in or near London in 1759, died 1797. Her early training was very defective, but, fitting herself for a teacher, she set up a school, in conjunction with her sisters, at Islington in 1783. In 1786 she published *Thoughts on the Education of Daughters*. This was followed by an answer to Burke's *Reflections on the French Revolution*, the *Vindication of the*

Rights of Woman, and other works. She had peculiar ideas on marriage, and lived for a time with an American called Inlay, to whom she bore a daughter. Inlay subsequently deserted her, and in 1796 she met William Godwin, who married her in 1797. She died soon after giving birth to a daughter, who became the wife of Shelley the poet. Among her other works are a *Moral and Historical View of the French Revolution*, and *Letters from Sweden, Norway, and Denmark*.—BIBLIOGRAPHY: *A Defense of the Character and Conduct of the late M. W. Godwin* (anonymous); E. R. Pennell, *Life of Mary Wollstonecraft*; *Love Letters of Mary Wollstonecraft to Gilbert Inlay*, with preface memoir by Roger Ingpen; G. R. S. Taylor, *Mary Wollstonecraft*.

Godwin, William, English novelist and political writer, son of a Dissenting minister, was born 1756, died 1836. In 1778 he became the minister of a Dissenting congregation near London, and continued in that capacity for five years, after which he removed to London, where he set himself to gaining his livelihood by literary labours. In 1793 appeared his *Inquiry concerning Political Justice*, the liberal tone of which exposed him to some danger of a Government prosecution. The next year appeared his novel of *Caleb Williams, or Things as they Are*, which rapidly and deservedly attained an immense popularity. His *Cursory Strictures on the Charge of Chief-Justice Eyre* (to the jury, in the trial for high treason of Holcroft, Horne Tooke, and others) contributed materially to the acquittal of his friends. In 1797 he published *The Inquirer*, a collection of essays on moral and literary subjects; and in April of the same year he married Mary Wollstonecraft (see preceding article). A memoir of his wife was published by Godwin in 1798, along with her posthumous literary works. In 1799 he published a new novel, *St. Leon*. Among his subsequent works are: *Faulkner*, a tragedy, published in 1807; an *Essay on Sepulchres*, in 1808; *Mandeville*, a novel, in 1814; *A Treatise on Population*, in reply to Malthus, in 1820; *History of the Commonwealth of England*, 1824–8; *Cloudesley*, a novel, in 1830; *Thoughts on Man*, in 1831; and *Lives of the Necromancers*, in 1834. In the latter years of his life Godwin held a clerkship in the Record Office.—BIBLIOGRAPHY: De Quincey, *Literary Reminiscences*; Sir L. Stephen, *English Thought in the 18th Century*; C. K. Paul, *William Godwin: his Friends and Contemporaries*; H. N. Brailsford, *Shelley, Godwin, and their Circle*.

Godwin-Austen, Mount, a great Himalayan peak, 28,278 feet high, next to Mount Everest, the highest on the globe. It received its name in 1888 after Lieutenant-Colonel H. H. Godwin-Austen.

Godwit, the common name of the members of a genus of birds (*Limosa*), belonging to the family Charadriidae (plovers). There are several species, of which two are migrant visitors to Britain but do not breed there, viz. the bar-tailed godwit (*L. lapponica*), and the black-tailed godwit (*L. belgica*). Godwits are long-legged birds with elongated slightly-upcurved beaks. The male helps to incubate the eggs.

Goes (hös), or Tergoes, a fortified town and port in Holland, in the province of Zeeland, on the Island of South Beveland, 16 miles west of Bergen-op-Zoom. It has a Gothic church and a city town hall, both dating back to the fifteenth century. It has a considerable commerce, but unimportant manufactures. Pop. 7620.

Goethe (geu'tè), Johann Wolfgang von, the greatest figure in German literature, was born on 28th Aug., 1749, at Frankfort-on-the-Main, died at Weimar, 22nd March, 1832. His father, who was a Doctor of Laws and Imperial Councillor, was a well-to-do citizen and an admirer of the fine arts. The Seven Years' War broke out when Goethe was eight years old, and Count de Thorane, *lieutenant du roi* of the French army in Germany, was quartered in the house of his father. The count, being an amateur and liberal patron of art, encouraged the boy's incipient taste for pictures. At the same time young Goethe learned the French language practically; and a French theatrical company, then performing at Frankfort, awakened his taste for dramatic performances. Drawing, music, natural science, the elements of jurisprudence, and the languages occupied him alternately. After the breaking off of a youthful love affair, which gave a name to the heroine of his great work *Faust* and some features to his *Wilhelm Meister*, he was sent to the University of Leipzig to prepare himself for the legal profession, but he did not follow any regular course of studies. It was during this period that Goethe developed the habit, which endured throughout his life, of embodying in a poem, or in a poetical form, whatever occupied his mind intensely, and no one, perhaps, was ever more in need of such a resource, as his nature continually hurried him from one extreme to another. In 1768 he left Leipzig, and, after an illness of some length, he went in 1770 to the University of Strasbourg to pursue the study of law, according to the wish of his father. At Strasbourg he became acquainted with Herder—a decisive circumstance in his life. Herder made him more acquainted with the Italian school of the fine arts, and inspired his mind with views of poetry more congenial to his character than any which he had hitherto conceived. While here he fell in love with Frederica Brion, daughter of the pastor of Sesenheim, but the affair, though it made a

more abiding impression on him than some others, resulted in nothing. Goethe's numerous love affairs form one of the most curious studies in biography. His attachments were all fugitive; the love passion was continuous, but the object was ever changing. In 1771 he took the degree of Doctor of Jurisprudence, and wrote a dissertation on a legal subject. He then went to Wetzlar to practise law, where he found, in his own love for a betrothed lady, and in the fate of a young man named Jerusalem, the subjects for his work *The Sorrows of Werther*, which formed an epoch in German literature. The attention of the public had already been attracted to him, however, by his drama *Götz von Berlichingen* (published 1773). *Werther* appeared in 1774.

Not long after the publication of *Werther*, Charles Augustus, the hereditary Duke of Saxe-Weimar, made the acquaintance of Goethe on a journey, and when in 1775 he took the government into his own hands, he invited Goethe to his court. Goethe accepted the invitation, and on the 7th of Nov., 1775, arrived at Weimar. Wieland was already there, having been the duke's tutor; Herder was added to the band in 1776; Schiller was afterwards one of its members for a few years; and other poets and critics and novelists were gathered round these chiefs. Goethe was the leading spirit of the group even during the last quarter of the eighteenth century, when these men and others were constructing and guiding the literature of all Germany; and his supremacy became yet more absolute afterwards, when for another generation he stood alone. In 1776 he was made Privy Councillor of Legation, with a seat and vote in the Privy Council. In 1782 he was made President of the Chamber, and ennobled. In 1786 he made a journey to Italy, where he remained two years, visited Sicily, and remained a long time in Rome. This residence in Italy had the effect of still further developing his artistic powers. Here his *Iphigenia* was matured, *Egmont* finished, and *Tasso* projected. The first of these was published in 1787, the second in 1788, and the third in 1790. In the same year as *Tasso* was published the earliest form of the first part of *Faust*, with the title *Dr. Faust, ein Trauerspiel* (Dr. Faust, a Tragedy), a poem in a dramatic form, which belongs rather to Goethe's whole life than to any particular period of it. At the time that Goethe was engaged in the production of these works of imagination he had been pursuing various other studies of a scientific nature with as ardent an interest as if these had belonged to his peculiar province. The result of his studies in botany was a work published also in 1790, *Versuch die Metamorphose der Pflanzen zu Erklären*, in which he gives

expression to the view that the whole plant, and its different parts, may all be regarded as variously modified leaves. In the following year (1791) he began to apply himself to optics, and in 1791-2 he published a work on this subject called *Beiträge zur Optik*. On the 1st of May, 1791, he became director of the court theatre at Weimar. In 1792 he followed his prince during the campaign of the Prussians against the revolutionary party in France, and was present at the battle of Valmy on the 20th of Sept.

At the Weimar theatre he brought out some of the dramatic *chefs-d'œuvre* of Schiller, and there, too, his own dramatic works first appeared, *Götz von Berlichingen*, *Faust*, *Iphigenia in Tauris*, *Tasso*, *Clavigo*, *Stella*, and *Count Egmont*. Between 1794 and 1796 Goethe published *Wilhelm Meisters Lehrjahre*, a novel which has become well known to English readers through the translation of Carlyle, and which had as a continuation *Wilhelm Meisters Wanderjahre* (that is, his travels as a journeyman; 1821). His next work of importance was *Hermann und Dorothea* (1797), a narrative poem in hexameter verse, the characters of which are taken from humble life. In 1806 Goethe married Christiane Vulpius, with whom he had lived since 1788, and of whom he always spoke with warmth and gratitude for the degree in which she had contributed to his domestic happiness. In 1808 he published another edition of *Faust* in a considerably altered form. In 1809 was published *Wahlverwandtschaften*, another novel, and in 1810 the *Farbenlehre*, a work in which he had the boldness to oppose the Newtonian theory, and to which Goethe himself attached great importance, although the theory therein promulgated has met with no acceptance among men of science. During 1811 and 1814 appeared Goethe's autobiography, with the title *Aus meinem Leben: Dichtung und Wahrheit*; in 1819 the *Westöstlicher Divan*, a remarkable collection of Oriental songs and poems. Goethe's last work was the second part of *Faust*, which was completed on the evening before the last anniversary of his birthday which he lived to see. Goethe's works taken altogether cover a wide range of subjects. His greatest production is his *Faust*, emphatically a philosophical dramatic poem, and the best of Goethe's productions in a department for which he seems to have been born. Much light is thrown on Goethe's life and character by the published correspondence with his contemporaries, Herder, Frau von Stein, Lavater, Jacobi, Merck, and Countess Stolberg; by Eekermann's *Conversations*; and especially by his own *Autobiography*, which he himself describes as 'poetry and truth', and in which probably the truth is sometimes clouded by the poetry. George Henry Lewes's *Life of*

Goethe is a standard work both in Germany and Britain.—**BIBLIOGRAPHY:** K. Goedeke, *Grundriss zur Geschichte der Deutschen Dichtung* (complete bibliography); G. H. Lewes, *Life of Goethe*; H. G. Atkins, *Johann Wolfgang Goethe*; Houston Stewart Chamberlain, *Goethe*; H. Düntzer, *Life of Goethe*; J. R. Seeley, *Goethe, reviewed after Sixty Years*; J. G. Robertson, *Goethe and the Twentieth Century*.

Gog and Magog. Ezechiel predicts the destruction of Gog and Magog (chap. xxxviii and xxxix) by the Jews, and mention is also made of them in *Revelation* (chap. xx). Interpreters generally understand them to be symbolical expressions for the heathen nations of Asia. Magog is mentioned as the second son of Japheth in *Genesis* (chap. x, 2).—Gog and Magog are also the names given to two reputed giants of early British history, whose statues are erected in the Guildhall in London. These statues are supposed to have been originally made for carrying about in pageants. The present figures of Gog and Magog, which are 14 feet high, were erected in 1708.

Gogol, Nikolai Vassiljevitch, Russian author, born in the province of Poltava 1809, died 1852. He went to St. Petersburg in 1829 and tried the stage, but, failing, found his true vocation in literature. His works are extremely popular in Russia for their graphic and humorous delineation of everyday life and manners, and more especially Russian country life. Among his most notable works are: *Evenings at the Farm* (1832); *Mirgorod* (1834), a collection of tales; *Dead Souls* (1842), a satirical novel, depicting the public abuses and barbarism of manners prevalent in the provinces; and *Revisor*, a comedy. His later years were tinged with religious mysticism, and he wrote some curious *Confessions*. Gogol is the father of Russian realistic literature. The latest complete edition of his works appeared in 1911, and contains a biography by Dimitry Mereshkovsky.—Cf. M. Baring, *Landmarks in Russian Literature*.

Gogra, the chief river of Oudh, forming an important water-way for that quarter of India. It is a tributary of the Ganges; length, 600 miles.

Goitre (goi'tér), or **Bronchocele** (bron'ko-sél), known also in Great Britain as 'Derbyshire neck', a disease endemic in Derbyshire, Switzerland, some parts of France and South America, and in many other parts of the world, chiefly in valleys and elevated plains in mountainous districts. It is a morbid enlargement of the thyroid gland, forming a soft and more or less mobile tumour or swelling, without any sign of inflammation, on the anterior part of the neck. It sometimes grows to such a size as to hang down over the breast, and respiration and swallowing

may be impeded by it, though often it causes little inconvenience. It is regarded as the result of a combination of causes, among which malarial influences probably concur with those of the drinking-water in developing the disease.

Gokcha, or **Goktscha**, a lake in Armenia, occupying a triangular cavity 540 sq. miles in extent, at an elevation of 6400 feet above the sea. It receives the water of several streams without having any considerable outlet.

Golborne, an urban district in Lancashire, $5\frac{1}{2}$ miles south by east of Wigan, with cotton manufactures, and a colliery. Pop. 7183.

Golcar, a manufacturing town in the West Riding of Yorkshire, 3 miles west by south of Huddersfield, on the River Colne. There is a mineral spa, and a brisk manufacture of woollen goods. Pop. 10,350.

Golconda, a fortress and ruined city of India in the Nizam's dominions, 7 miles west of Hyderabad. The fort is now used as the Nizam's treasury, and also as a State prison. In former times Golconda was a large and powerful kingdom of the Deccan, but was subdued by Aurangzib in 1687, and annexed to the dominions of the Delhi Empire. It used to be famous for diamonds.

Gold is a precious metal of a bright yellow colour, and the most ductile and malleable of all the metals; symbol, Au (Lat. *aurum*); atomic weight, 197.2. It is one of the heaviest of the metals, and, not being liable to be injured by exposure to the air, is well fitted for coins and jewellery. Its ductility and malleability are very remarkable. It may be beaten into leaves so exceedingly thin that 1 grain in weight will cover 56 square inches, such leaves having the thickness of only $\frac{1}{222,000}$ th part of an inch. It is also extremely ductile; a single grain may be drawn into a wire 500 feet long, and an ounce of gold covering a silver wire is capable of being extended upwards of 1000 miles. It may also be melted and remelted without loss by oxidation. It is soluble in nitro-muriatic acid or *aqua regia*, and in a solution of chlorine. Its specific gravity is 19.3, or it is about nineteen times as heavy as water. The fineness of gold is estimated by carats, pure gold being 24 carats fine. (See *Carat*.) Gold is seldom used for any purpose in a state of perfect purity on account of its softness, but is alloyed with some other metal to render it harder. Standard gold, or the alloy used for the gold coinage of Britain, consists of twenty-two parts of gold and two of copper (being thus 22 carats fine). Articles of jewellery are made of varying degrees of fineness up to 22 carats, i.e. twenty-two parts of gold to two of alloy, the legal standards being 9, 12, 18, and 22. The alloy of gold and silver is found in the native state. It is of a paler yellow than pure gold, while the copper alloy has a colour

bordering upon reddish yellow. Palladium, rhodium, and tellurium are also met with as alloys of gold.

Gold has been found in smaller or larger quantities in nearly all parts of the world. It is commonly found in reefs or veins with quartz, and in alluvial deposits. Among the latter may be ranked the deposits in river beds, from which the gold is obtained by dredging. When gold is in rock, quarrying, crushing, washing, and treatment with mercury are employed. The rock is crushed by machinery, and the crushed material is treated with mercury, which dissolves the gold, forming a liquid amalgam, after which the mercury is volatilized, and the gold left behind. Two other processes are also in use, viz. the chlorination and the cyanide. In the former the gold is transformed into soluble gold chloride, and the metal is obtained from this solution by means of ferrous sulphate, charcoal, or sulphuretted hydrogen. This process is rapidly being displaced by the cyanide process (see *Cyaniding*). The cyanide process is the most important method of treatment, is suitable for ores in a fine state of division, and consists in dissolving the metal in dilute potassium cyanide solutions, from which it can be obtained by precipitation on zinc. The gold obtained by these methods always contains silver, from which it is separated by the process known as 'parting', which consists in the solution of the silver in sulphuric or nitric acid, and washing and melting down the gold. Electrolysis is also used for the parting of gold and silver, and when only small quantities of silver are present, chlorine is passed through the molten metal, thus forming silver chloride, which rises to the top and covers the pure gold left behind. In alluvial (or *placer*) deposits it is extracted by washing, in the form of dust, grains, laminæ, or nuggets. After the gravel has been turned over and any nuggets have been taken out, the remainder is washed to recover the finer particles of gold. In washing in the pan—'panning out'—a quantity of the 'dirt', free from stones, is put into a shallow dish with a slight depression in the middle. It is then mixed with water, and the dish held with one side lower than the other, while by a gentle motion the sand and other lighter bodies are washed over the edge of the pan, and the heavy matters containing the gold remain at the bottom. The 'cradle' consists of a short box or trough 6 or 7 feet long, mounted on a kind of rockers, and slightly inclined to allow the mud to run off. A box, with a bottom of iron plate perforated with holes, is placed over the higher end of the trough. The 'pay dirt' (i.e. gravel or sand containing a sufficient amount of gold to be profitably worked) is thrown into this box, and water is run or poured upon it. The finer

portion is thus carried through the holes, and directed by an inclined plate into the trough. The cradle is rocked from side to side, the light matters are carried away by the water, and the particles of gold and other heavy matters lodge behind the 'riffles', or transverse bars of wood, with which the bottom of the trough is fitted, and are afterwards collected. Where practicable, the method known as 'sluicing' is often adopted for treating alluvial deposits. The 'sluices' consist of troughs called 'flumes', in sections about 12 feet long, inclined on trestles. The bottom of the sluice-box is crossed by 'riffle' bars of wood or iron. The smallest of the sluices consists of two such sections. Into the upper one the gravel is thrown, and the lower end is closed by an iron grid to keep back the pebbles and large stones, while the sand, &c., pass through to the lower trough. In this it deposits its gold and heavy matters behind the riffle bars. In the longer sluices (say 250 feet long) the lower end of the upper section is not blocked, but near it the bottom consists of an iron grating—the 'grizzly'. The large stones are washed forward over the grating, but the sand and fine particles carried by the water fall through it on to the second section of the sluice. In some cases the fine sand, after passing through the first section of the sluice, falls on inclined tables covered with blankets, rough cloth, or hides with the hairy side up, over which it flows in a thin stream. These 'blanket-strakes' serve to arrest and recover the fine gold. In other cases amalgamated copper plates are employed for the same purpose.

Where water is plentiful, 'hydraulic mining' is the cheapest mode of working. Under this system 'deep leads' (which are alluvial deposits covered over with more recent matter in ancient river beds) and other alluvial deposits are worked by washing down the gravel by means of a powerful jet of water, a head of 200 to 250 feet being sometimes employed. In quartz mining—and the case is similar with the hard, solid 'banket' formation of South Africa that contains the gold—the ore to be crushed is first passed through a 'stone-breaker' or 'ore-crusher', and is further crushed by the 'stamps' or other grinding-mill. The ordinary stamp-battery consists, in its lower part, of a cast-iron 'mortar-box', fitted on one or both sides with a fine screen. At the bottom of this box is a row of iron blocks called 'dies', upon which the stamps, or heavy cylindrical cast-iron blocks, are made to rise and fall by means of cams, being thus kept pounding away at the ore in the mortar-box. A stream of water is admitted, and carries the crushed material through the screens. Mercury is fed into the mortar-boxes in small quantities, and much of the gold is retained there

on amalgamated copper plates. Slightly inclined amalgamated plates, arranged in steps, are placed in front of the battery, and over these the crushed ore pulp passes slowly, the gold being retained by the amalgamated surfaces. The remaining product, or 'tailings', which may still contain some gold, is then treated either by 'concentration' and the concentrates smelted, cyanided, or chlorinated, whilst the remaining tailings are submitted to treatment by the cyanide process, or the whole is treated by the cyanide process. For the concentrating process 'vanners' are generally employed. These consist of a slightly-sloping table, formed of an endless travelling belt of india-rubber, which is stretched over rollers and so mounted as to be capable of violent agitation (the vibrations numbering 200 a minute) while moving slowly in an upward direction. The pulp is led on at the higher end, and the flow of water carries the light matters down the slope, the separation being greatly assisted by the shaking movement. The heavy matters only are carried forward by the belt over the higher end, and pass into a box below, being then known as 'concentrates'.

In modern practice of gold-milling, that is, the extraction of the metal from vein material or rocks, there is a tendency to reduce the importance of extraction by means of mercury and to depend mostly on the dissolving power of cyanide solutions. In order to get efficient extraction, the material to be treated is crushed to an extremely fine state of division known as slime. The most convenient method of carrying this out is by rock-breakers, then stamps, followed by treatment in tube-mills, which consist of horizontal revolving steel cylinders, about 5 feet in diameter and 14 to 22 feet long, charged with flint pebbles, the ore pulp being fed at one end, and the slime being discharged at the other end. The tube-mill can do satisfactory work only with material that has been crushed medium fine, so that it is usual to take the material from the stamp-batteries, which may or may not have passed over amalgamated copper plates, to a classifier. This classifier is so arranged that the very fine material which does not need further crushing overflows at the top and the sandy material is separated and passed to the tube-mill for sliming. The capacity and nature of product of the tube-mill are governed by the nature of the ore, the degree of preliminary crushing, the rate of feeding, the weight of pebbles, the revolutions per minute of the mill, and the amount of water used. The slimed material from the tube-mills is frequently passed over amalgamated copper plates for the purpose of collecting any free gold which may be present. The final slime is passed to thickeners for the removal of some of the water, and then to

agitation-tanks, where cyanide of soda or potash is added and the whole agitated, either by mechanical means or by blowing air through a pipe situated in a central tube of larger diameter placed in the pulp. In this latter method the specific gravity of the central column of pulp is decreased and circulation of the pulp set up. After sufficient agitation in the tanks, the pulp is removed and submitted to filtration, either in pressure or vacuum filters, the gold-bearing cyanide solution being removed for precipitation of the gold, either by passing it over zinc shavings or by agitation with zinc dust. The precipitate of gold thus obtained is refined by treatment with acid for the removal of the remainder of the zinc, and the resulting gold is melted down.

Gold was probably the first metal to attract the attention of man, its presence in the native condition, its brilliant lustre, and its malleability rendering it an object of value from the earliest times. Although widely distributed in nature, it is only found in a few localities in sufficient quantities to repay the extraction costs. The chief producers of gold in the order of their importance are: Africa, United States, Australasia, Mexico, Russia, Canada, India, China, and South America. The total value of the gold produce of the world from 1493 to 1850 is estimated at £862,900,000. An immense increase in the world's production was caused by the discovery of gold in California in 1848 and Australia in 1851, the world production between 1851 and 1885 being estimated at £890,500,000. Since 1884 the gold-fields of South Africa have become of increasing importance, and with the exception of war years have shown a constant increase in yield year by year. The Transvaal has been mainly responsible for this increase, and since 1902 has been the greatest gold-yielding country in the world. Rhodesia and West Africa also yield much gold. In the United States the chief gold-producing states are Colorado, California, Nevada, and Alaska, although other states also yield gold. Considerable gold-fields exist in the western portion of the North American continent, reaching from Mexico up to British Columbia and the Klondyke district. In Russia gold is abundant in the Ural Mountains; in India the most important locality is that of the Kolar gold-fields in Mysore. In China gold has long been mined in the province of Shantung. In the United Kingdom gold has been found in Cornwall, Sutherlandshire, Perthshire, Wicklow, and has been worked to some extent in Wales. In 1887 the world's production was estimated at £22,000,000; in 1907 at £83,000,000; and in 1918 at about £90,000,000. —BIBLIOGRAPHY: G. Lock, *Gold: its Occurrence and Extraction*; T. K. Rose, *Metallurgy of Gold*;

J. H. Curle, *Gold Mines of the World*; T. C. Earle, *Gold Dredging*; J. Park, *The Cyanide Process of Gold Extraction*; C. B. Horwood, *Gold Deposits in the Rand*.

Goldau (gold'ou), a valley in Switzerland, in the canton of Schwyz, between the Rigi and the Rossberg. It was the scene of a tremendous landslide (2nd Sept., 1806) by which a portion of the Rossberg, about 3 miles long, 1000 feet broad, and 100 feet thick, fell in one mass into the valley, burying villages and killing over 450 persons.

Gold-beating, the art or process of producing the extremely thin leaves of gold used in gilding. The gold is cast into ingots weighing about 2 ounces each, and measuring about $\frac{1}{2}$ of an inch broad. These ingots are passed between steel rollers till they form long ribbons of such thinness that a square inch will weigh $6\frac{1}{2}$ grains. Each one of these is now cut into 150 pieces, each of which is beaten on an anvil till it is about an inch square. These 150 plates are interlaid with pieces of fine vellum about 4 inches square, and beaten till the gold is extended nearly to the size of the vellum leaves. Each leaf is then divided into four, interlaid with gold-beater's skin, and beaten out to the dimensions of the skin. Another similar division and beating finishes the operation, after which the leaves are placed in paper books ready for use.

Gold Coast, a British Crown Colony in West Africa, on the Guinea coast, between Togoland and the French Ivory Coast, stretching inland so as to include the Ashanti country; estimated area of Gold Coast, Ashanti, and Protectorate, 80,000 sq. miles. The first settlements on this coast were made by the Portuguese, who built the fort of Elmina, seized by the Dutch in 1637. Subsequently a number of Dutch and English settlements were established, but the former were transferred to Britain in 1872. Ashanti was definitely annexed in 1901, after having given much trouble. The chief (coast) towns are: Accra (the capital), Cape Coast Castle, Elmina, Adda, Quitta, Axim, and Sekondi (from which there is a railway to Coomassie). The chief products are gold (£1,403,760 in 1919), palm-oil and kernels, rubber, cocoa, kola nuts, and timber. Imports for 1919, £7,946,981; exports, £10,814,175. Pop. 1,503,386.

Golden Age, that early mythological period in the history of almost all races, fabled to have been one of primeval innocence and enjoyment, in which the earth was common property, and brought forth spontaneously all things necessary for happy existence, in which men did not engage in warfare, while beasts of prey lived at peace with other animals. The Romans referred this time to the reign of Saturn. The term 'golden age' is often applied to the finest

period of Latin literature (Cicero to Ovid) in contradistinction to the 'silver age' (from the death of Augustus to that of Hadrian).

Golden-beetle, the popular name of several beetles of the genus *Chrysomela*. There are some British species, but most are tropical. Their most obvious characteristic is the great brilliancy of their colour. There are none of large size.

Golden Bull (*bulla aurea*), an important document in the history of Germany issued by the Emperor Charles IV in 1356. Its immediate object was to regulate for all time coming the mode of procedure in the election and coronation of the emperors. Another document, also called Golden Bull, was issued in 1222 by Andrew II, King of Hungary, its object being to transform the government from an absolute to an aristocratic monarchy.

Golden - crested Wren, **Gold - crest**, **Golden-crested Regulus**, or **Kinglet** (*Regulus cristatus*), a beautiful bird belonging to the sub-family Sylviinae (warblers), distinguished by an orange crest. It is the smallest of British birds, being only about $3\frac{1}{2}$ inches in length, is very agile, and almost continually in motion. The upper part of the body is yellowish olive-green, all the under parts pale reddish-white, tinged with green. The most usual haunts of the golden-crested wren are tall trees, particularly the oak, the yew, and the various species of pine and fir. Its nest is most commonly open at the top, but sometimes it is covered with a dome, and has an opening on one side. It is always ingeniously suspended beneath the branch, being the only instance of the kind amongst the birds of Great Britain. The eggs are six to ten in number. Closely related, and very similar in appearance, is the fire-crest (*R. ignicapillus*), an occasional winter visitor to Southern England.

Golden Deities. The connection of gold with the sun ('the golden sun') and deities having solar attributes is of great antiquity. This precious (sacred) metal had originally a magico-religious significance. It was used in ancient Egypt to make models of cowries and snail shells, and the earliest gold jewellery found in the Nile Valley included a necklace of imitation shells (G. A. Reisner, *Early Dynastic Cemeteries of Naga-ed-Dér*, vol. i, plates 6 and 7). The gold was found on the trade-route between the Nile and the Red Sea, the special province of the goddess Hathor, one of whose names was 'Nubt'. A collar adorned with golden amulets was in Egyptian hieroglyphs the sign 'nub' (gold), and Nubia was 'gold-land'. It was apparently because Hathor had originally been in one of her phases a personification of the cowry that she became, as the goddess of the gold cowry, the 'Golden Hathor', the prototype of the 'Golden Aphrodite' (Venus). Among the earliest

gold ornaments found by Schliemann at Troy were models of cowries. As the shells were supposed to contain the animating principle ('soul substance'), the virtue of these appears to have passed to the precious metal. In China gold was used with jade and pearls to stuff the mouths of dead emperors and other members of the royal household, so as to preserve the body from decay and assist the soul to rise to the celestial regions. The vital energy in gold was derived from *Yang* matter which was concentrated, according to Chinese belief, in the sun. The golden deities of Greece were supposed to have acquired their golden hair by washing it in a river. Gold was in ancient times greatly favoured for ear-rings. It is of interest to note in this connection that ear-rings were connected with the sun, and that the human sons of the solar deity were fabled to have emerged from one of their mother's ears. Arjuna, the Aryo-Indian hero, son of Surya, the sun god, emerged from the ear of his mother, the Princess Pritha. The gold ear-ring was reputed to strengthen the eyes of wearers. This belief may have arisen from the ancient belief that the sun and the moon were the eyes of the world-deity. The Chinese dragon-gods were supposed to have had their origin from gold of various colours. The Egyptian alchemists produced gold of various tints by mixing metals. 'Green gold' was a mixture of 26 per cent silver and 75 per cent gold. In ancient Egypt electrum was found as a natural alloy, the proportion of silver being one-fifth. Electrum is found in Sutherland, Scotland, in small quantities.

Golden Fleece, in classical mythology, the fleece of gold of the ram Chrysomallus, in quest of which Jason undertook the Argonautic expedition to Colchis. The fleece was suspended from an oak tree in the grove of Ares (Mars), and was guarded by a dragon. When the Argonauts came to Colchis for the fleece, Medea put the dragon to sleep and Jason carried the fleece away.

Golden Fleece, Order of the, the *Toison d'or*, a military order instituted by Philip the Good, Duke of Burgundy, in 1430, on the occasion of his marriage with the Portuguese princess, Isabella. The order now belongs both to Austria and Spain. The knights carry suspended from their collars the figure of a sheep or fleece in gold.

Golden Horde, originally the name of a powerful Mongol tribe, but afterwards extended to all the followers of Genghis Khan, and of Batu, the grandson of Genghis Khan, who invaded Europe in the thirteenth century. Under Batu the Golden Horde advanced westwards as far as the Plain of Mosi in Hungary, and Liegnitz in Silesia, at both of which bloody battles were fought in 1241. They founded the empire of the Kiptshaks, or the Golden Horde,

which extended from the banks of the Dniester to the Ural, and from the Black Sea and the Caspian to the mouth of the Kama and the sources of the Khoper. This empire lasted till towards the close of the fifteenth century, when it was overthrown by Tsar Ivan III.—Cf. S. Lane-Poole, *Mohammedan Dynasties*.

Golden Legend (*Aurea Legenda*), a collection of legends of the saints made in the thirteenth century by Jacobus de Voragine, or James of Viraggio, Archbishop of Genoa (died 1298). It consists of 182 sections, each of which is devoted to a particular saint or festival, arranged in the order of the calendar. Caxton printed a translation in 1483, and another edition was produced by Wynkyn de Worde in 1498. A modern edition of the work appeared in 1900. There is a poem entitled *The Golden Legend* by Longfellow.

Golden Number, in chronology, a number showing the year of the moon's cycle; so called from having formerly been written in the calendar in gold. To find the golden number add 1 to the given year, and divide the sum by 19, what remains will be the number required, unless 0 remain, in which case 19 is the golden number.

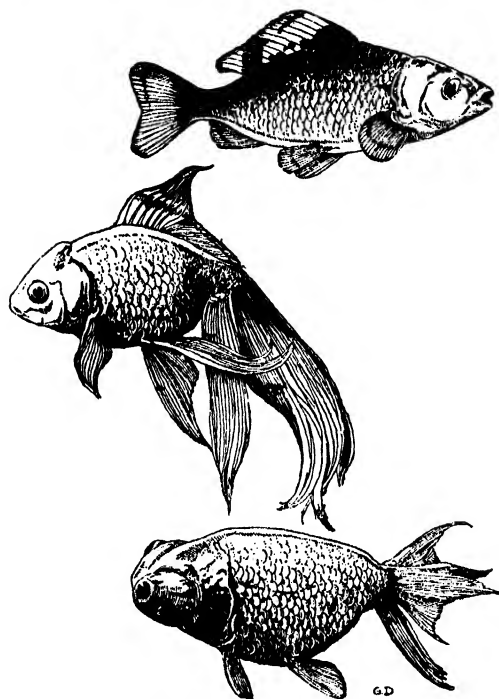
Golden-rod (*Solidago*) is a genus of plants, nat. ord. Compositæ, chiefly natives of North America. Most of the species have erect, rod-like, scarcely-branched stems, with alternate serrated leaves, and terminal spikes or racemes of small yellow flowers. *S. virgaurea*, often called Aaron's Rod, is the only British species, and is common in woods and heathy thickets.

Golden Rose, in the Roman Catholic Church an ornament of gold consecrated by the Pope on the fourth Sunday of Lent. It was originally a single flower of wrought gold, coloured red; afterwards the golden petals were decked with rubies and other gems; finally the form adopted was that of a thorny branch, with several flowers and leaves, and one principal flower at the top, all of pure gold. It is sent to some favoured Catholic prince or princess whom the Pope wishes to honour, to some eminent church, or distinguished personage. The custom is supposed to have originated in the thirteenth century. Henry VIII and Mary of England, James IV of Scotland, Mary Casimir, Queen of Poland, Isabella II of Spain, and Napoleon III were among the recipients of the golden rose.

Golden-saxifrage, the popular name for plants of the genus *Chrysosplenium*, a small genus of Saxifragaceæ, consisting of annual or perennial rather succulent herbs, with alternate or opposite crenate leaves, and inconspicuous greenish axillary and terminal flowers. They are natives of Central and Northern Europe, the Himalayas, and parts of America. There are two British species.

Goldfinch, a common British bird, the *Carduelis elegans*, belonging to the Finch family. It is about 5 inches in entire length, black, scarlet, yellow, and white being beautifully mingled in its plumage. The colours of the female are duller than those of the male. The nest is an elegant cup-shaped structure. Its brilliant plumage, soft and pleasant song, and docility make it a favourite cage-bird. Goldfinches feed on various kinds of seeds, particularly those of the thistle, dandelion, and groundsel.

Goldfish, the popular name for a beautiful species of carp (*Carassius auratus*), found in the



Goldfish: some curious forms

fresh waters of China and Japan. It is greenish in colour in the natural state, the golden-yellow colour being found only in domesticated specimens, and retained by artificial selection. These fishes are reared by the Chinese in small ponds, in basins, or porcelain vessels, and kept for ornament. By careful selection, many strange varieties and monstrosities have been propagated. They are now distributed over nearly all the civilized parts of the world, but in large ponds they readily revert to the colour of the original stock.

Gold Lace, a fabric woven of silken threads which are either themselves gilt or are covered with fine gilt silver wire. In the former the gold-

leaf is fixed directly on the threads by means of gum. In the latter and finer kind the fine gilt silver wire is twisted compactly round the silk-threads, which are then ready for being manufactured into lace.

Gold of Pleasure, the *Camelina sativa*, a cruciferous annual, ord. Cruciferae, with stem-clasping leaves, and terminal racemes of yellow flowers which produce pear-shaped pods containing numerous small seeds. It is found in Britain in cornfields, and is cultivated to a considerable extent on the continent of Europe for its seeds, which yield an oil used for burning, for dressing woollen goods, making soft soap, and in painting. The stems yield a fibre commonly used for making brooms.

Goldo'ni, Carlo, the most celebrated Italian writer of comedies, born at Venice in 1707, died at Paris 1793. He early showed a taste for theatrical representations, and when scarcely eight years of age he ventured to sketch a comedy, which excited the wonder of his relatives. His father, who was a physician, intended that his son should follow the medical profession, but Goldoni, dissatisfied with this study, obtained permission to study law in Venice. Soon after, however, a relative procured for him a place in the Papal college at the University of Pavia, from which he was expelled for writing scurrilous satires. After his father's death he settled as an advocate in Venice, but soon took to a wandering life with strolling players, until in 1736 he married the daughter of a notary of Genoa, and settled down in Venice. Here he first began to cultivate that department of dramatic poetry in which he was to excel; namely, description of character and manners. In this he took Molière, whom he began to study about this time, for his model. For five years he visited various cities of Italy, composing pieces for different theatrical companies, and for a time renewing his legal practice. In 1731 the Italian players invited him to Paris, where many of his pieces met with uncommon applause. He became reader and master of the Italian language to the daughters of Louis XV; and was granted a pension of 3600 livres. At the breaking out of the Revolution the poet lost his pension, and the decree of the National Convention of the 7th of Jan., 1793, restoring it and making up the arrears, found him already in the arms of death. His widow received the arrears and a pension for herself. Many of his numerous pieces still retain possession of the stage in his native country, and, in translations, of the stages of foreign countries. Among his best-known comedies (about 150) are: *La Donna di Garbo*, *Pamela Nubile*, *Todero Brontolom*, *La Casa Nova*, *Il Vecchio Bizarro*, and *L'Adulatore*.—Cf. Copping, *Alfieri and Goldoni: their Lives and Adventures*.

Goldschmidt, Madame. See *Lind, Jenny*.

Gold-sinny, or Connor, *Crenilabrus melops*, a small fish of the British seas; one of the wrasse family.

Goldsmith, Oliver, Irish poet, playwright, and novelist, was born at Pallas, County Longford, 10th Nov., 1728, and died 4th April, 1774. Goldsmith's father was a clergyman of the Established Church, with a large family and a small income. Goldsmith attended the village school, then kept by one 'Paddy' Byrne, a former soldier who had acted as quartermaster during Marlborough's campaigns. Byrne, who was an original character, seems to have had an important influence upon Goldsmith, and was blamed by the poet's family for imbuing him with a wandering and unsettled turn of mind. When aged about eight, Goldsmith had a severe attack of smallpox, which disfigured him greatly, and made him very sensitive. After leaving the village school, he went to schools at Elphin, Athlone, and Edgeworthstown. On 11th June, 1744, he was admitted to Trinity College, Dublin, as a sizar. In those days sizars received free board and tuition in return for performing certain menial duties. The position entailed a good deal of humiliation, and Goldsmith was acutely sensitive about it. Many stories and legends are still preserved of his scrapes and escapades at college. His tutor was a brutal and unsympathetic man, and did not see any remarkable qualities in his pupil. Goldsmith became a B.A. on 27th Feb., 1749. His name was last on the list. He now coquetted with each of the learned professions in turn. He presented himself to the Bishop of Elphin for ordination, but as he appeared in brilliant scarlet breeches, he was turned down. He borrowed £50 from his uncle in order to study law, but was cheated of it before he got farther than Dublin. He then left Ireland—for ever, as it turned out—and went to Edinburgh to study medicine under Alexander Monro, the first of a dynasty of that name which reigned in the chair of anatomy at Edinburgh for over a hundred and twenty years. Goldsmith remained two years in Edinburgh, and then in 1754 went to complete his studies on the Continent. A certain element of myth surrounds his adventures there. He studied at Leyden and Louvain, and went on foot through France, Germany, Switzerland, and Italy, supporting himself by playing on the flute, or by disputing with scholars at convents or universities, like the Admirable Crichton. He himself alleged that he took the M.B. degree somewhere; it has been thought it was either at Padua or Louvain; it has also been thought that he imagined the incident. Anyhow, when he landed in England on 1st Feb., 1756, he was a distinguished graduate of the world's university. He had seen

many sides of life, and was destined to see many more. He became an apothecary's assistant, an usher, a reader to Richardson (the novelist and printer), and a poor physician. Finally he began to do hack-work for various publishers, commencing by writing many reviews and critiques.

Goldsmith's literary works may be divided into two classes: those which were original, and those which were compilations. As an author he had almost a dual personality, like Dr. Jekyll and Mr. Hyde. Dr. Jekyll wrote the *Inquiry into the State of Polite Learning*, the *Essays*, the *Bee*, the *Citizen of the World*, the *Vicar of Wakefield*, and the poems and plays. Mr. Hyde, meanwhile, was busy at histories of Greece, Rome, and England, and at a work on natural history entitled *Animated Nature*, as well as writing various shorter works such as the *Life of Beau Nash*, *Memoir of Voltaire*, and *Life of Bolingbroke*. It is not necessary to say much of Goldsmith's compilations. Even in them he displays his beautifully easy style, his own distinct way of writing. He was not a scholar by nature, and did not wish to undertake any laborious investigations, even had his slave-drivers given him time for them. Gibbon almost persuaded him to write an account of Alexander the Great's campaign against Montezuma. In his *Animated Nature* he was sometimes indebted to his imagination for his facts. In his accounts of battles he takes the old-fashioned, not to say Homeric, view that it is only the leader on either side who really matters. Yet, in spite of some obvious absurdities, his compilation work is good, as he rendered attractive subjects which often become dry in more scholarly hands.

His original works are, however, on a different plane altogether. In them he expressed his unique personality. No one ever put so much of himself into his books as Goldsmith. His longer poems *The Traveller* and *The Deserted Village* are excellent poems of a didactic kind, exquisitely expressed. *The Traveller* made Goldsmith's reputation, and helped him into the best literary society in London. There has been much debate as to whether Auburn is the village of Lissoy in Ireland or an English village. It is really probably situated in Maritime Bohemia. His lighter poems, *The Launch of Venison* and *Retaliation* especially, are delightful. *Retaliation* is a masterpiece of urbane satire, which combines compliment and banter while describing the characters of some of his friends, such as Garrick, Burke, and Reynolds. Of the two plays, *She Stoops to Conquer* (1773) is a good deal better than *The Good Natur'd Man* (1768). The latter is a good comedy of manners, modelled upon Goldsmith's compatriot Farquhar; it has two well-drawn characters, Croaker and Lofty, but

is not entirely successful. *She Stoops to Conquer* is a splendid comedy of intrigue, introducing lively and farcical incidents and highly-drawn pictures of eccentric characters. The central incident, the mistaking of a house for an inn, is based upon a misadventure of the author's youth. This comedy still holds the stage, and is as amusing to-day as when it was first produced. It did much to kill the taste for sentimental or genteel comedies, such as those of Cumberland.

Some of the *Essays*, both those in the *Bee* and those not, are good, as is also the *Inquiry*. None of these are perhaps supremely good. *The Citizen of the World* (1762), in which a Chinaman describes English manners and customs, contains pieces more characteristic of Goldsmith, especially in the passages describing Beau Tibbs. These passages are as good as anything in Addison. Goldsmith's great masterpiece, however, is *The Vicar of Wakefield*, which Johnson sold for £80 in 1762, but which did not appear until 1766. The plot is full of inconsistencies, and is less skilfully manipulated as the story progresses, and the book is made the right length by means of poems, tales, and a sermon; but in spite of these faults it is a real classic. Dr. and Mrs. Primrose, Moses and his green spectacles, Olivia and Sophia, and the Misses Flamborough will live as long as any characters given us by Dickens, Thackeray, or Fielding. It is at once humorous and pathetic; unlike his contemporary Sterne, Goldsmith could be sentimental without being unmanly. By 1886 ninety-six different editions of it had been published.

Goldsmith was a friend of all the most notable literary men of his day: Johnson, Burke, Gibbon, Garrick, Boswell, and Reynolds. They seem to have regarded him with affectionate toleration, as one would regard a child. Indeed, like Peter Pan, he seems to have refused to grow up. He had many amiable weaknesses: a taste for gaudy clothes, a liking for gambling, and an ambition to shine in conversation. Nature had made him an exquisite writer, but a poor talker. He was recklessly charitable when he had any money. He is said to have died £2000 in debt, and his financial troubles hastened his end. He died in April, 1774, having unwisely prescribed a patent medicine James's powder, for himself. He was buried in the burial-ground of the Temple Church. The cenotaph erected in Westminster Abbey has upon it a Latin epitaph by Johnson which contains the happiest verdict that can be given upon Goldsmith: "Nullum fere scribendi genus non tetigit; nullum quod tetigit non ornavit"—he touched almost every kind of writing, and touched none that he did not adorn.—BIBLIOGRAPHY: J. Forster, *Life and Adventures of Oliver Goldsmith*; Sir James Prior, *Life of*

Oliver Goldsmith; Austin Dobson, *Life of Goldsmith* (Great Writers Series); W. Black, *Goldsmith* (English Men of Letters Series).

Gold-Stick, a designation for the captain of the gentlemen-at-arms and the colonel of the Life Guards, from the gilt rod carried by them when attending on the sovereign on state occasions.

Gold Workings, Ancient. So far as is known, gold was first worked in Ancient Egypt where it acquired a magico-religious value (see *Golden Deities*). Auriferous quartz veins are found in intrusive rocks among the large mountain masses of hornblende granite in the Nile valley, especially between latitude 27° and 21°. Traces of extensive ancient mine workings indicate that a great amount of gold was obtained in the Eastern Desert. An ingot of gold was found in a pre-dynastic grave at El-Kab; there are in Cairo museum pre-dynastic flint knives with handles of gold. The chief source of Ancient Egyptian gold was the Wadi Allagi, where the hills "have the appearance of having been ploughed. Quite 100 sq. miles of country", writes E. S. Thomas in *The Cairo Scientific Journal*, "have been worked to an average depth of 7 feet. So thoroughly has this been done that only the merest traces of gold remain."

Near old mine workings 5 miles north-east of Wadi Hammamat 2000 old stone houses have been found. Wilkinson counted 1320 huts near the old Fowachir workings which are close to Wadi Hammamat. In some mining areas the stone washing tables still remain. Ancient mine workings at Um Rus, 140 miles east of Luxor, were reopened in 1904 by a company. They were found "to extend 1500 feet along the line of the reef and to a maximum depth of 202 feet". This mine is believed to be the one referred to by Agatharchides (113 B.C.), who wrote: "Even in our time are found cutting hammers of brass and human bones in incredible numbers, crushed perhaps in these wide ill-propped galleries so vast and deep that they reach the sea". A great deal of gold was exported from Ancient Egypt to Western Asia as the Tel-El-Amarna tablets bear evidence. Akhenaton, the heretical Pharaoh (1375-1358 B.C.) received frequent requests for gold from the kings of Cappadocia, Assyria, and Babylonia. Ramses III presented about £18,000 worth of gold to the gods. It is estimated that Ptolemy II derived about 4 millions sterling from the gold-mines. In the old mine workings on the Sudan border a great deal of Roman pottery has been found. After the death of Cleopatra, such large quantities of gold and silver reached Rome that the loan rate of interest dropped from 12 to 4 per cent. It is believed that much of the gold came from the Egyptian mines. The method of working gold in ancient

times is described in a narrative transcribed by Diodorus Siculus. It is told that galleries were driven into the rock by strong young men who used hammers. Young lads carried out the fragments, which were taken by old men to the 'pounders' where middle-aged men broke the quartz in the mortars. The broken quartz was then ground in hand-mills by women. Three women worked each mill, and to those "who bear this lot", says the ancient writer, "death is better than life". Men spread out the milled quartz on sloping tables, kneading it after it was drenched with water. Others used sponges to remove the lighter parts and separate the gold. The washing process was continued until the gold was fit to be placed in clay pots in which it was mixed with lead, salt, silver, and bran. The pots were sealed and set on fires for five days and five nights. In Asia the demand for gold in ancient times caused prospectors to search for it far and wide. Gold was found on the Chota-Nagpur plateau and Malabar coast in India, and in Assam and in northern Burma, as well as in Tibet. The Altai mountains (gold mountains) yielded considerable supplies. In Europe gold was found in Spain, Portugal, and France, in Cornwall and Devon and northern Wales, in various parts of Scotland, and in north-eastern and southern and south-western Ireland. Egyptian Empire period finds in Rhodesia indicate that the prospectors reached even that distant part of Africa. It is believed that the Phœnicians who circumnavigated Africa visited the Gold Coast and obtained the precious metal there.

Golf, a game played with clubs and balls over large commons, downs, or links. It is said to have originated in Holland, and the word golf itself is doubtfully derived from the Dutch *kolf*, a club. It has been played in Scotland for centuries, and there are several references to the game in Scottish Acts of Parliament, as in one passed in 1491 under James IV, which classes football and 'gouff' with "uthir sic unprofitable sportis". It was not till the middle of the nineteenth century that the game really began to take root in England, although the golf club with the oldest records is that at Blackheath, founded by James I, or his Scottish courtiers. Apart from this, the first English golf-club was started at Westward Ho, Devonshire, in 1864; and gradually this was followed by other clubs all over the country. The Royal and Ancient Club of St. Andrews (founded in 1754) is now the recognized head-quarters of the game in the United Kingdom, and long laid down the law for the golfing community. Recently a Rules of Golf Committee has been formed; but all its members are members of the St. Andrews club, which thus practically maintains its supremacy.

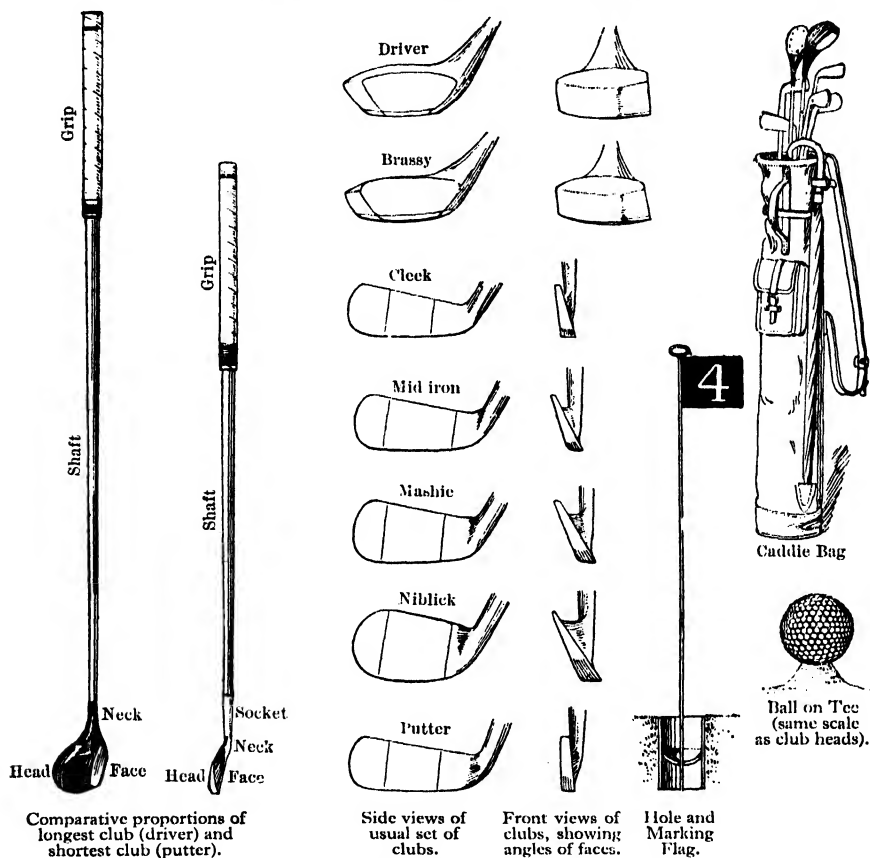
Other well-known golf-courses or links are at North Berwick, Prestwick (near Ayr), and Muirfield (Haddingtonshire), in Scotland; Westward Ho, Hoylake, and Sandwich, in England; and Portrush, in Ireland. A golf-club was founded at Calcutta in 1829, Bombay and Pau (in the south of France) coming next in order. The game spread to the United States, through Canada, about 1890, and has since become amazingly popular there.

It may be said that a golf-course will sooner or later always be laid down in any part of the world where Scotsmen congregate. The best courses are at sea-level, where sandy soil, covered with short turf and provided with natural sandy 'bunkers' and with a fair supply of gorse, constitute ideal conditions. But often the worst natural disadvantages are either overcome by skilled artificial additions or overlooked by enthusiasts who will play whatever the circumstances, and one finds links in the most unexpected surroundings, e.g. at the top of a high mountain, as in Switzerland. The game is unique; it combines healthy exercise and recreation in good air with a maximum of variation and a minimum of fatigue; so that whilst the most vigorous devotees will be found among the young or early middle-aged, even the comparatively senile take advantage of the remarkable opportunities it offers. Of recent years ladies have displayed equal keenness, and have developed such skill that the champion lady player is very little inferior to the greatest male exponents of the game.

The varying nature of the ground on a golf course, and the different obstacles to be surmounted, necessitate the use of a number of different clubs. The chief clubs are the *driver*, *brassy*, *cleek*, *mashie*, *iron*, *niblick*, and *putter*. Of these the first two have wooden heads, the rest iron, though the putter is often made of aluminium. The heads of wooden clubs are made of beech, persimmon, or logwood, weighted with lead behind, and protected with horn at the bottom. The shafts are usually of hickory, and are spliced to the heads and bound with strong twine. The *driver* is the club used for the first drive from the 'teeing-ground', but may also be used for other strokes if the 'lie' of the ball is good. It is the longest club of all, and has an exceedingly springy and supple shaft. A good driver will send the ball, if accurately hit, some 200 yards. The *brassy* is a somewhat similar club, but is shorter, less springy, and is shod with a brass plate. Its face is laid back somewhat, so as to 'loft' the ball, and it is used in fairly good 'lies' on grass. The *cleek*, an iron club with a flat face, is used for drives of from 100 to 150 yards, or where the lie of the ball is such that a wooden club cannot be used. Both the

mashie and the *iron* are used for lofting the ball out of bunkers or over obstacles, or for short 'approaches', and accordingly have their faces laid back, the *mashie* having the shorter head of the two. The *niblick* has a very short spoon-shaped head, and serves to extricate the ball from deep sand, small holes, cart-ruts, &c. The *putter* is used on the 'putting-green' for coaxing

to be more springy, and can be driven farther than the older gutta-percha balls. It is a peculiar feature of golf that it is the only ball game which does not require the use of a ball of standard size or weight. Quite recently an attempt has been made to introduce the standard ball, and the opinions of leading amateurs and professionals upon this suggested innovation have been most



Golf Clubs, Caddie Bag, &c.

the ball into the hole from short distances. A great many varieties of this club have from time to time been introduced by prominent players, whose success has induced enthusiastic novices to endeavour to emulate their skill by adopting the same implement. The other clubs are on the whole stereotyped. The ball, which was originally of feathers covered with leather, was afterwards always made of gutta-percha, and now usually consists of a core round which india-rubber thread is wound, the whole being cased with gutta-percha. These balls have been found

interesting. On the whole the general opinion has been an adverse one, the chief opposition being from the leading professionals, who think they would thereby sacrifice some of their driving superiority. In the United Kingdom open and amateur championships are decided annually on the greens at St. Andrews, Prestwick, Muirfield, Hoylake, and Sandwich in rotation. Ladies' championships are also held.

A golf-course of full size is divided into eighteen sections by a series of small round holes, $4\frac{1}{2}$ inches in diameter, sunk in the turf at dis-

tances of from 100 to 500 yards from each other, so as to form a circuit or round; many courses have only nine holes. The ground between the holes must be varied in character, being diversified by obstacles, whether natural or artificial, such as sand or other bunkers, hillocks, ditches, streams, &c. Round each hole a grass-grown space, known as the putting-green, is kept perfectly smooth. The object of the game is, starting from the first teeing-ground (or place from which the balls are driven off towards each hole), to drive the ball into the next hole in as few strokes as possible, and so on with all the holes in succession, the side which 'holes out' on any occasion in the fewest strokes being said to win the hole. The match is decided either by the greatest number of holes won, or by the aggregate number of strokes for the whole round. In medal play, and in some championships, the score is always reckoned by strokes. Often what are known as 'Bogey' competitions are held. 'Colonel Bogey', who is a kind of 'Mrs. Harris' of golf, has a fixed score allotted to him for each hole, this score being approximately that of a good player who accomplishes the round without making any bad blunders. 'Bogey', in fact, is a perfect player who always plays up to his best form whatever the conditions. The competitors contest each hole with this mythical opponent, and the winner is he who finishes the greatest number of holes 'up', or more generally the least number 'down', on 'Bogey'. Ordinarily the ball may not be touched otherwise than with the club during the game, except to take it out of the hole and place it in position on the teeing-ground (the 'tee' being a little mound of sand, on which the ball is placed for the first drive to each hole). Sometimes, however, the local rules of a club recognize certain places on the course from which the ball is practically unplayable, and if a ball lodges in one of these places, the player is allowed to take it out and drop it behind him under penalty of one stroke.—BIBLIOGRAPHY: H. G. Hutchinson, *Golf Greens and Green Keeping*; *The New Book of Golf*; G. W. Beldam, *Great Golfers*; H. Hilton and G. G. Smith, *The Ancient and Royal Game of Golf*. See also *The Golfer's Annual* and *The Golfer's Year-Book*.

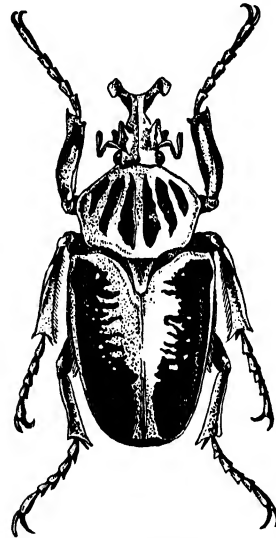
Goliath, a Philistine giant of Gath slain by David (1 Sam., xvii). His height was "six cubits and a span", which, taking the cubit at 21 inches, would make him a little over 11 feet. The *Septuagint* and Josephus make him only "four cubits and a span", or 7 feet 9 inches.

Goliath-beetle, the popular name of the beetles of the genus *Goliathus*, natives of tropical Africa, remarkable for their large size, and on account of their beauty and rarity much prized

by collectors. The largest species (*G. druryi*) attains the length of 4 inches.

Golosh'es, a word introduced into our language from the French *galoches*, but originally derived from the Spanish *galocha*, meaning a wooden shoe or clog (cf. Gr. *kalopodion*, *kalon*, wood, and *pous*, foot). It was formerly applied by the English to a kind of wooden clogs. The name is now restricted to overshoes, now generally made of vulcanized india-rubber.

Goltz, Baron Colmar von der, German soldier and author, born at Bielkenfeld, East Prussia, 12th Aug., 1843, died 4th April, 1916. Entering



Goliath-beetle (*Goliathus druryi*)
(half natural size)

the Prussian infantry in 1861, he fought in the Austrian campaign of 1866 and in the Franco-Prussian War, when he was attached to the head-quarters staff of Prince Frederick Charles. He then served on the historical section of the general staff in Berlin, lectured on military history, and in 1883 went to Turkey for the purpose of reorganizing the Turkish army, and remained there until 1895. He received the title of Pasha, was made field-marshal, and in 1908 went again to Constantinople, where he was instrumental in furthering the Young Turk movement. He revisited Constantinople in 1909 and in 1910. In 1913 he retired from the Prussian army, but at the outbreak of the European War he accompanied the German army, and was Governor of Brussels from Sept. to Oct., 1914, and afterwards Governor of Belgium. In 1915 von der Goltz again went to Turkey, where he supervised the defences of the Dardanelles and the Turkish

operations against the Allies. He died, or, as some say, was assassinated, at his head-quarters in April, 1916. His works include: *Gambetta and his Armies* (1877), *The Nation in Arms* (1883), and *The War History of Germany in the Nineteenth Century*.

Go'marites, or **Gomarists**, followers of *Francis Gomarus* (1563–1641), a Dutch disciple of Calvin in the seventeenth century. The sect, otherwise called Dutch Remonstrants, very strongly opposed the doctrines of Arminius, adhering rigidly to those of Calvin. See *Reformed Church*.

Gome'ra, one of the Canary Islands, about 12 miles by 9 in extent; pop. 19,736. It has two towns, St. Sebastian and Villa Hermosa.

Gom'ersal, a town in the West Riding of Yorkshire, England, 5 miles s.s.e. of Bradford, with several collieries, worsted mills, and manufactures of blankets and cloth. Pop. 3796.

Gomez, Sebastiano, Spanish painter, born at Seville about 1646, died about 1690. He was a mulatto, originally a slave of Murillo, but on account of his talent he was liberated by his master and became one of his pupils, after his death painting some pictures for churches and convents in Seville.

Gompers, Samuel, American labour leader, of Jewish extraction, born in London 27th Jan., 1850, where he was apprenticed to a cigarette-maker. He went to the United States in 1863, and as a boy already became a zealous worker in the cause of labour. One of the founders of the American Federation of Labour, he became its president in 1881. An active organizer of the labouring classes, he became an indefatigable champion of labour legislation, and through his efforts the American Labour Federation became a powerful organization. When America entered the European War, Gompers used his influence in support of the Allied cause, opposing not only communist ideas as introduced into Russia by the Soviets, but also socialism. A labour leader, Gompers has nevertheless always remained a staunch supporter of the capitalistic régime. He visited Britain, France, and Italy in 1918, was president of the International Commission on Labour Legislation at the Paris Peace Conference, and president of the International Labour Conference at Washington in 1919. His works include: *The American Labour Movement*, and *American Labour and the War*.

Gomperz, Theodor, Austrian philologist and classical scholar, born 29th March, 1832, at Brünn, died in 1912. He studied at the University of Vienna, where he became professor of classical philology. He occupied this post from 1873 to 1901, when he entered the House of Peers. Gomperz is well known for his decipherment of the papyri of Herculaneum. His works

include: *Herculanische Studien* (1865–6); *Beiträge zur Kritik und Erklärung der Griechischen Schriftsteller* (7 vols., 1875–1900); *Platonische Aufsätze* (3 vols., 1887–1905); *Griechische Denker* (3 vols., 1893–1909; English translation by Magnus and Berry, 4 vols., 1905–12).

Gomul Pass, a pass across the Sulaimán range, from the Punjab into Afghanistan. It follows the course of the Gomul River, and is an important trading highway.

Gomu'ti Palm, the sago-palm (*Arenga saccharifera*), which yields a bristly fibre, resembling black horsehair, known as gomuti. This fibre, which is also called *ejoo*, is manufactured into cordage, plaited into ornaments, employed for thatching, and put to various other similar uses. The sweet juice yielded by the palm is fermented, forming the 'toddy' of the natives. In Malacca the gomuti is cultivated chiefly for its saccharine juice, which is crystallized into the sugar named jaggery. It is also one of the sago-producing palms.

Gonaives, a town on the west coast of Haiti, on the bay of the same name, 65 miles n.n.w. of Port au Prince. It has an excellent harbour. The exports are cotton, coffee, salt, and mahogany. It was at Gonaives that the independence of Haiti was proclaimed by Dessalines in 1804. Pop. about 8000.

Goncharov, Ivan Alexandrovitch, one of the most eminent Russian novelists, born at Simbirsk, July, 1812, died Sept., 1891. He studied at the University of Moscow, accepted a post in the Ministry of Finance, and was subsequently in the Censor's office. He went round the world as secretary to Admiral Putiatin in 1852. For a time he was editor of the *Northern Post*. His first novel, *A Common Story*, appeared in 1847, and his master-work, *Oblomov*, in 1857. This novel is a personification of the apathy which has characterized and still continues to characterize the Russian nation. In a clear masterly way Goncharov depicted therein the intellectual and moral life of his nation, its lack of will-power, and its chronic indolence as typified in his hero Oblomov.—Cf. P. Kropotkin, *Russian Literature*.

Goncourt (gon-kör), Edmond and Jules de, French novelists and writers on social history, art, &c.; brothers, born respectively in 1822 and 1830, died 1896 and 1870. As novelists they belonged to the Realistic school, but they depicted life and character in a less coarse fashion than Zola. Their historical and biographical works dealt chiefly with the eighteenth century, and especially the period of the Revolution. Edmond left a fund for the establishment of an *académie* of men of letters. Their works include: *Portraits Intimes du XVIII^e Siècle*, *L'Art du XVIII^e Siècle*.—Cf. F. Brunetière, *Le Roman Naturaliste*.

Gonda, chief town of district of the same name, Oudh, India, 28 miles N.N.W. of Fyzábád. Pop. 17,400.—The district has an area of 2881 sq. miles. Pop. about 1,500,000.

Gondar, a chief town of Abyssinia, formerly the residence of the king, and still the ecclesiastical head-quarters, is situated on a hill of considerable height, about 22 miles north of Lake Dembea. The town is divided into several quarters; contains many churches, and the ruins of a magnificent towered castle, built in the sixteenth century by Indian architects under the direction of Portuguese settlers. It was burned by King Theodore in 1868. Pop. about 7000.

Gondo'koro, a station and port on the Upper Nile (Bahr el Gebel), in Uganda, at the head of steamer navigation. At one time it was the chief seat of the Egyptian Government of the Upper Nile. In recent times it has again risen in importance.

Gon'dola, a sort of barge, curiously ornamented, and navigated on the canals of Venice.



Gondola

The ordinary gondolas are upwards of 30 feet long and 4 feet broad; they always terminate at each end in a very sharp point, which is raised perpendicularly to the height of a man. Towards the centre there is a curtained chamber for passengers.

Gonds, a Dravidian people the aboriginal inhabitants of the old territorial division of Hindustan called Gondwana, corresponding pretty nearly to what is now called the Central Provinces. The name Gond has been connected with *Telugu Konda*, a mountain, which would tend to prove that they are a hill tribe. After a long period of repression, the Gonds attained to a position of great prominence and power, and in the sixteenth, seventeenth, and eighteenth centuries three Gond dynasties simultaneously held almost the whole of Gondwana under their sway. With the rise of the Mahrattas the power of the Gonds declined, and in 1781 the last of their dynasties was overthrown and the independence of the Gonds

ceased. Their numbers have been variously estimated up to 2,000,000, partly under feudatory states and partly under the British Government, in the Central Provinces. They used to offer human sacrifices to their deities, but now sacrifice instead an image of straw. They worship objects which are supposed to be the abode of spirits, and are reputed sorcerers. Less than a fortieth of Dravidian-speaking peoples speak the uncultivated dialect known as Gond. —BIBLIOGRAPHY: S. Hisslop, *Papers relating to the Aboriginal Tribes of the Central Provinces*; J. Forsyth, *The Highlands of Central India*.

Gon'falon (O.Fr. *gonfanon*), an ensign or standard; especially an ensign having two or three streamers or tails, fixed on a frame made to turn like a ship's vane, or, as in the case of the Papal gonfalon, suspended from a pole like a sail from a mast. In many of the mediæval republican cities of Italy the bearer of the gonfalon was often the chief personage in the state, and was called a *gonfalonier*.



Gonfalon

Gong, a Chinese musical instrument made of an alloy of copper (about seventy-eight parts) and tin (about twenty-two parts), in form like a round flat dish with a rim 2 to 3 inches in depth. It is struck by a kind of drumstick, the head of which is covered with leather, and is used for the purposes of making loud sonorous signals, of marking time, and of adding to the clangour of martial instruments.

Gongo'ra y Argo'te, Luis de, a celebrated Spanish poet, was born at Cordova in 1561, died there in 1627. He was educated for the Church, and was made chaplain to the king, and a prebendary in the cathedral of Cordova. His works consist chiefly of lyrical poems, in which he excelled. He introduced a new poetic phraseology called the *estilo cullo*, and founded a school of writers, the *Gongoristas*, who carried this depraved style to an absurd length. His poems were published at Madrid in 1627. *Gongorism* is a style somewhat resembling Euphuism in England or Marinism in France.

Goniatites, an extinct group of shell-bearing cephalopods, now divided into many genera, such as *Glyphioceras*, *Gastrioceras*, &c., and ranging from the Ordovician to the Carboniferous system. The partitions in the shell are bent in an angular manner where they meet the wall, thus foreshadowing the complex suture-lines of the ammonites. The siphuncle connecting the chambers lies, as in the ammonites, against the outer side of the shell, that is, against the convex side in coiled forms; but the cal-

careous necks where it passes through the partitions are directed backwards, as in the nautiloids. Almost all the forms are closely coiled, and in marine Coal Measure beds they are familiar as small globose fossils.

Gonlom'eter (Gr. *gōnia*, angle, and *metron*, measure), an instrument for measuring solid angles, particularly the angles formed by the faces of crystals. The *reflecting goniometer* is an instrument of this kind for measuring the angles of crystals by determining through what angular space the crystal must be turned so that a ray reflected from two faces successively shall have the same direction. The angle of rotation is the supplement of that between the faces.

Gonorrhœa is a specific contagious disease marked in its early stage by a profuse purulent discharge from the affected part—in the male, the urethra, and in the female, the vagina. It is due to an organism called the gonococcus, and the usual means of spread of the infection is sexual intercourse.

It is the more common of the two widespread venereal diseases, and though popularly supposed to be much less dangerous than syphilis, when treatment is neglected, the disease, especially in women, may have most far-reaching and devastating effects. After the acute stage, lasting from ten days to three weeks, the symptoms lessen, and it is frequently at this point that treatment is abandoned too early, with the result that the infection spreads inwards, leading in later years to bladder troubles and stricture in the male, and infection of the internal genital organs with resulting sterility in women.

Gonsal'vo, Hernandez y Aguilar, de Cordoba, Spanish soldier, called the *great captain* (*el gran capitan*), was born at Montilla, near Cordova, in 1453, died at Granada 1515. He distinguished himself in the Portuguese War which began in 1475, and in the great war with the Moors, which ended with the conquest of Granada in 1492. In 1495 he was sent to assist Ferdinand II, King of Naples, against the French, who occupied the whole of that kingdom. In less than a year Gonsalvo drove the French over the Neapolitan frontiers, and returned to Spain, where he was engaged in subjecting the Moors in the Alpujarras when Louis XII of France renewed the war against Naples. Gonsalvo again took the field, and by the victory near Seminara in 1502 obtained possession of both Calabrias. In 1503 he gained a still more important victory near Cerignola, in consequence of which Abruzzo and Apulia submitted, and Gonsalvo marched into Naples. He then sat down before Gaëta. As the siege was protracted, he gave up the command to Don Pedro Navarro, and advanced to meet the enemy.

He defeated the Marquis of Mantua; and on the Garigliano, with 8000 men, obtained a complete victory over 30,000 French, the consequence of which was the fall of Gaëta. The possession of Naples was now secured. He was Viceroy in Italy until 1507, when, through the jealousy of the king and the calumnies of the courtiers, he was deprived of his office, and retired to Granada, where he died.—Cf. W. H. Prescott, *Ferdinand and Isabella*.

Gonville and Calus (kēz) College, Cambridge, was founded in 1358 by Edmund Gonville of Terrington, Norfolk. In 1558 Dr. Caius obtained the royal charter by which all the former foundations were confirmed and his own foundation was established. By this charter the college was thenceforth to be called Gonville and Caius College.

Gonzaga Family, a famous Italian family who ruled over Mantua from 1328 to the beginning of the eighteenth century. Many illustrious soldiers, statesmen, churchmen, and promoters and cultivators of arts, science, and literature sprang from this stock. They became extinct in 1708.

Good, John Mason, English physician, author of various poems, translations, and professional treatises, was born 1764, died 1827. He was apprenticed to a surgeon at Gosport, and in 1784 engaged in practice at Sudbury. In 1793 he removed to London, where he carried on business for several years as a surgeon and apothecary. He obtained the diploma of M.D. from the University of Aberdeen in 1820, and from that date till his death practised exclusively as a physician. His best-known work is a blank verse translation of Lucretius's Latin poem *De Rerum Natura*. Other translations by him are *The Song of Songs* and *The Book of Job*. He also wrote *The Study of Medicine* and *The Book of Nature*; and published in conjunction with his friend Olinthus Gregory a cyclopædia entitled *Pantologia* (in 12 vols.).

Good-Friday, a fast of the Christian Church in memory of our Saviour's crucifixion, kept on the Friday of Passion Week, that is, the Friday before Easter. It has been celebrated from a very early period. In the Roman Catholic Church the celebration of this fast includes prayers for all classes of people, including heretics, schismatics, pagans, and Jews, and the 'Adoration of the Cross', but no mass is celebrated. In Protestant Churches, with but a few exceptions, the day is observed with more or less solemnity. The practice of eating 'cross-buns' on this day has now no religious significance. In England and Ireland Good-Friday is a general holiday; in Scotland it is a bank holiday.

Good King Henry. See *Goosefoot*.

extremity; there are about seven species. The goosander or merganser proper (*M. merganser*) weighs about 4 lb. It is an Arctic bird, moving south in winter, and in severe seasons frequents the lakes and rivers of Britain. It feeds principally on fish, which it seizes by rapid diving. The red-breasted goosander (*M. serrator*), a frequent visitor to Britain, measures about 21 inches in length, and weighs about 2 lb. The smew (*M. albellus*) ranges across the northern part of the Old World, and migrates southward in winter. Other species are native to America, Brazil, Central Asia, and the Auckland Islands. The hooded goosander (*Lophodytes cucullatus*) is peculiar to North America.

Goose, the common name of the birds belonging to a subdivision (Anserinæ) of the duck family. The two sexes are similar in appearance. The domestic goose lives chiefly on land and feeds on grass; there are many varieties, but they do not differ widely from each other. It is valued for the table, and on account of its quills and fine soft feathers. The common wild goose, or grey-lag (*Anser cinereus*), which is migratory, possibly represents the original stock of the domestic goose. The *Snow-goose* (*Chen hyperboreus*) of North America is 2 feet 8 inches in length, and its wings are 5 feet in extent. The bill of this bird is very curious, the edges having each twenty-three indentations or strong teeth on each side. The inside or concavity of the upper mandible has also seven rows of strong, projecting teeth, and the tongue, which is horny at the extremity, is armed on each side with thirteen long and sharp bony teeth. The flesh of this species is excellent. The *Laughing* or *White-fronted Goose* (*Anser albifrons*) inhabits the northern parts of both continents, and migrates to the more temperate climates during the winter. The *bean-goose* (*A. segetum*) is also common to both continents. The *Canada-goose* (*Bernicla Canadensis*) is the common wild goose of the United States, and is known in every part of North America. It is also found in Europe, and even breeds in Britain. Other species are the *bernacle goose* (*B. leucopsis*) and the *brent-goose* (*B. branta*); the *red-breasted goose* (*B. ruficollis*), that ranges southward from Western Siberia and figures in ancient Egyptian printings; and the *pink-footed goose* (*Anser brachyrhynchus*) of North Europe.

Gooseberry (*Ribes grossularia*), a low, branching shrub, growing wild in Siberia and the north of Europe, other species being found in North America. Along with the currants it forms the ord. Grossulariaceæ, which is now usually combined with Saxifragaceæ. The branches are armed with numerous prickles, and bear three- to five-lobed leaves and inconspicuous flowers. The fruit is a succulent berry, very

wholesome and agreeable, of various colours—whitish, yellow, green, and red. Gooseberries are popular fruits for preserving, and are extensively cultivated, being of very easy culture. They may be raised from slips, which is the usual mode of perpetuating varieties; new varieties are raised from seed. The plant of four years old produces the largest and finest fruit; afterwards the fruit becomes smaller but increases in quantity. *R. niveum*, an American species, has fine white flowers, and is cultivated as an ornamental shrub.

Goosefoot (*Chenopodium*) is a genus of plants, nat. ord. Chenopodiaceæ, indigenous



Goosefoot (*Chenopodium album*)

Detail of flower at right.

to the temperate parts of the eastern continent. They are weedy plants common in waste places, and bear small greenish flowers, which are sessile in small clusters, collected in spiked panicles. Several species are found in Britain. *C. Bonus-Henricus*, English mercury, or Good King Henry, is a substitute for spinach. The seeds of *C. quinoa* of Peru are used as food.

Gopher, the name of various burrowing animals, natives of North America. The *Geomys bursarius* or pouched rat has large cheek-pouches extending from the mouth to the shoulders, incisors protruding beyond the lips, and broad, mole-like fore-feet. Several American forms (species of *Spermophilus*), intermediate between marmots and true squirrels, also get this name; as also a species of burrowing land-

tortoise (*Testudo polyphemus*) of the Southern States, whose eggs are valued for the table.

Göppingen (geup'ing-en), a town of Würtemberg, 22 miles E.S.E. of Stuttgart. It is regularly built; contains a handsome church, town house, old castle, and hospital; and has a mineral spring; manufactures of woollen and linen cloth, hats, and paper. Pop. 21,020.

Gorakhpur, a town of Hindustan, United Provinces of Agra and Oudh, capital of the division and district of same name, on the left bank of the Rapti. It has a considerable trade in grain and timber, sent down the Rapti to the Gogra and the Ganges. Pop. 56,890.—The division has an area of 9543 sq. miles. It is generally flat, and traversed by numerous streams, of which the principal are the Rapti and larger Gandak. Pop. of division, 6,524,420.

Goramy, or **Gourami** (gō-ra-mī', gō-ra-mī'), the Javanese name of a fish of the genus *Osphromenus* (*O. olfax*), family Osphromenidae, a native of the Malay Archipelago, but introduced into the Mauritius, India, and Guiana (where it has multiplied rapidly) on account of the excellence of its flesh. It is deep in proportion to its length, and the dorsal and anal fins have numerous short spines, while the first ray of the ventral is protracted into a filament of extraordinary length. The male constructs a nest of air-bubbles, cemented together by a secretion of the mouth cavity, and he guards the eggs and young.

Gordianus, M. Antonius, the name of three Roman emperors, father, son, and grandson. The first was born in A.D. 158, and had governed Africa for many years, when he was proclaimed emperor at the age of eighty. He associated his son with him in the empire, but six weeks later the son was killed in fighting against the rival emperor, Maximinus, and the father, in an agony of grief, died by his own hand. The grandson was proclaimed emperor by the soldiers in Rome A.D. 238, although he was not more than fifteen years of age. He reigned six years, when he was assassinated by his soldiers at the instigation of Philip, prefect of the Prætorian guard.

Gordius, in Greek legend, a Phrygian peasant, father of Midas, who was raised to the Phrygian throne in accordance with an oracle which declared to its Phrygian consultants that their seditions would cease if they elected as king the first man they met, mounted on a chariot, going to the temple of Zeus. This was Gordius, who, to evince his gratitude, consecrated his chariot to Zeus, and fastened the pole with so ingenious a knot that the oracle promised the dominion of the world to him who should untie it. Alexander the Great cut it with his sword, and to 'cut the Gordian knot' became a proverb.

Gordon, Adam Lindsay, Australian poet, was

born in 1833 at Fayal, in the Azores, and died in 1870. Educated at Cheltenham, Woolwich, and Oxford, he left England when he was twenty for South Australia, and joined the mounted police. He subsequently tried horse-breaking, entered the Colonial Assembly as member for Victoria district, and became noted as an adventurous steeple-chaser. His first volume of poems, *Sea Spray and Smoke Drift* (1867), met with a very favourable reception, as did also *Bush Ballads and Galloping Rhymes* (1870), which depicted bush life with marvellous fidelity. He committed suicide the same year. He also wrote *Ashtaroth: a Dramatic Lyric*. His poems were edited by Marcus Clarke in 1880, and there have been various other editions, one by Douglas Sladen in 1912. See *Colonial Literature*.

Gordon, Charles George, British soldier, known also as 'Chinese Gordon' and 'Gordon Pasha', was born at Woolwich 1833, killed at Khartoum 1885. He entered the Royal Engineers in 1852, and served in the Crimea (1854-6). During the Taiping Rebellion in China Gordon succeeded in completely crushing the revolt by means of a specially-trained corps of Chinese, exhibiting marvellous feats of skilful soldiery. On his return to England with the rank of colonel, he was appointed chief engineer officer at Gravesend, where his military talents and philanthropy were conspicuously displayed. From 1874 to 1879 he was Governor of the Sudan under the Khedive. For a few months in 1882 he held an appointment at the Cape, and he had just accepted a mission to the Congo from the King of the Belgians, when he was sent to withdraw the garrison shut up in the Sudan by the insurgent Mahdi. He was shut up in Khartoum by the rebels, and gallantly held that town for a whole year. A British expeditionary force under Lord Wolseley was dispatched for his relief; an advance corps sighted Khartoum on 24th Jan., 1885, to find that the town had been treacherously betrayed into the hands of the Mahdi two days before, and Gordon murdered. Gordon's character was marked by strong religious feelings, which became so intensified as to make him somewhat of a religious enthusiast and fatalist. — **BIBLIOGRAPHY:** A. E. Hake, *The Story of Chinese Gordon*; A. Forbes, *Chinese Gordon*; Sir W. F. Butler, *Charles George Gordon*; D. Boulger, *Life of Gordon*; W. S. Blunt, *Gordon at Khartoum*; Lytton Strachey, *Eminent Victorians*.

Gordon, Family of, a celebrated Scottish historical House, the origin of which is still wrapped up in a certain measure of obscurity. It is probable that the family came over to England with William the Conqueror, and at a subsequent period settled in Berwickshire, where a parish and village bear this name. The

adhesion of Sir Adam Gordon, Justiciar of Lothian, to the cause of Bruce gave him estates on Deeside and the Spey Valley. The direct male line died out in the person of Sir Adam of Gordon, who fell in the battle of Homildon (1402), but from his female and illegitimate descendants a number of branches sprang up. His grandson was made Earl of Huntly (1445). The head of this branch was made marquess in 1599, and Duke of Gordon in 1684. The dukedom became extinct in 1836. The title Marquess of Huntly passed to a branch of the family which had acquired the title of Earl of Aboyne in 1660. The dukedom was revived in 1876, and given to the Duke of Richmond and Lennox, a nephew of the last duke. The Barons Lochinvar, the Viscounts Kenmure, and the Earls of Aberdeen are (or were) all branches of the Gordon family. Other members of the family became Earls of Sutherland. Lord Byron's mother was a Gordon.—Cf. J. M. Bulloch, *The House of Gordon*.

Gordon, Lord George, son of Cosmo George, Duke of Gordon, born 1751, died 1793. He entered when young into the navy, but left the service during the American War. In 1774 he became a member of the House of Commons, and his parliamentary conduct was marked by a certain degree of eccentricity, and by his opposition to the Ministry. A Bill having been introduced into the House for the relief of Roman Catholics from certain penalties and disabilities, in June, 1780, Lord George headed an excited mob of about 100,000 persons, who went in procession to the House of Commons to present a petition against the measure. The dreadful riots, known as the 'No Popery' Riots, which ensued led to his arrest and trial on the charge of high treason; but, no evidence being adduced of treasonable design, he was acquitted. In the beginning of 1788, having been twice convicted of libelling the French Ambassador, Marie Antoinette, then Queen of France, and the criminal justice of his country, he retired to Holland, but he was arrested, sent home, and committed to Newgate, where he passed the remainder of his life. He was undoubtedly crack-brained. Dickens's *Barnaby Rudge* is in part a narrative of the Gordon Riots.—Cf. R. Watson, *The Life of Lord George Gordon*.

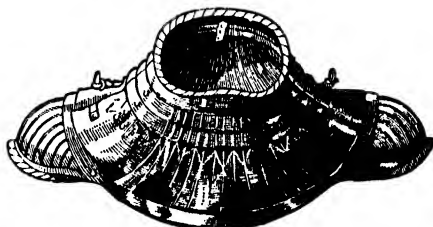
Gordon, Sir John Watson, Scottish painter, and president of the Royal Scottish Academy, was born in Edinburgh in 1788, died 1864. He applied himself almost exclusively to portrait-painting, in which he attained great excellence. He was employed to paint the portraits of many of the most eminent Scotsmen of the day. In 1879 his brother and sister endowed the Watson-Gordon Professorship of Fine Art, instituted in his memory in Edinburgh University.

Gordon, Patrick, a Scottish soldier, born 1635, died at Moscow 1699. In 1661 he entered the Russian service, became a general, and rose high in favour with Peter the Great. He kept a diary for the last forty years of his life, part of which was edited for the Spalding Club in 1859.

Gore, Catherine Grace, English novelist, born 1799, died 1861. In 1823 she was married to Charles Arthur Gore of the 1st Life Guards, and shortly afterwards appeared her first novel, *Theresa Marchmont, or the Maid of Honour*. She wrote altogether from sixty to seventy novels, clever pictures of fashionable life, among the best of which are *Preferment*; *The Courtier of the Days of Charles II*; *Cecil, or the Adventures of a Coxcomb*; *The Hamiltons*; *The Banker's Wife*; *Pin Money*; *Peers and Parvenus*; and *Temptation and Atonement*. She was also the author of a tragedy, *Lord Dacre of the South*; and two successful comedies, *A Quid pro Quo*, and *The School for Coquettes*.

Goree', a small island, or rather rock, belonging to France, on the coast of Africa, a little more than a mile from the southern shore of the promontory that forms Cape Verde. The town of Goree contains about 2000 inhabitants, and has been supplanted by Dakar.

Gorget (Fr. *gorge*, throat), a piece of body armour, either scale work or plate, for the pro-



Gorget, 1535 (after Planché)

tection of the throat. The *camail*, or throat covering of chain mail, which is sometimes called the gorget of mail, belonged more to the helmet than to the body armour.

Gorgias (gor'ji-as), Greek orator and sophist, born at Leontini, in Sicily, about 480 B.C. When about sixty years of age, he was sent as ambassador to Athens, where he spent the greater part of his remaining years. He was a popular teacher of rhetoric, had many distinguished pupils, and is protagonist in the *Gorgias* of Plato. Gorgias is said to have reached the extraordinary age of 107 or 108 years. Two works attributed to him are extant, *The Apology of Palamedes*, and *The Encomium on Helena*, but their genuineness has been questioned.—Cf. T. Gomperz, *Greek Thinkers*.

Gorgons (Gr. *Gorgōnes*, terrible ones), in Greek

mythology, three monsters whose names were Stheno, Euryale, and Medusa, daughters of Phoreys and Ceto. They were all immortal, except Medusa. Their hair was said to be entwined with serpents, their hands were of brass, their body was covered with impenetrable scales, their brazen teeth were as long as the tusks of a wild boar, and they turned to stones all those who looked upon them. Medusa was killed by Perseus (q.v.), and her head was afterwards placed on the Aegis of Athena. From her blood the winged horse Pegasus is supposed to have sprung.—(Cf. J. C. Lawson, *Modern Greek Folklore*).

Gorgonzo'la, a town and commune, Italy, 12 miles E.N.E. of Milan. It has a fine modern church, and a trade in a kind of ewe-milk cheese. Pop. 5190.

Goril'la, *Gorilla gorilla*, the largest animal of the ape kind. It attains a height of about



Gorilla (*Gorilla gorilla*)

5½ feet or more, is found chiefly in the woody equatorial regions of Western Africa, is possessed of great strength and fierceness, is a great frequenter of trees, and feeds chiefly on vegetable substances, as roots and fruits. The erect position is more readily assumed by the gorilla than by most of the other anthropoid apes, owing to the shape of the sole of the foot, which is not inverted, and is shorter and broader; but the ordinary gait is on all fours. It has a ferocious and brutal cast of features, due to the prognathism of the jaws, the extremely prominent supra-orbital ridges, and retreating forehead.

Gorillas make a sleeping-place somewhat like a hammock, connecting the branches of a tree by means of the long, tough, slender stems of climbing plants, and lining it with dried fronds of palms or long grass. This abode is constructed at different heights from the ground, but there is never more than one such nest in a tree. The gorilla, like the chimpanzee, has thirteen ribs, whereas man and the orang have twelve. The bones of the arm are much longer than in man, and the upper arm is longer than the forearm; the leg bones are shorter than in man. In the proportion of its molar teeth to the incisors and in the form of its pelvis it approaches somewhat closely the human form. It is less intelligent and docile than several other apes.

Göritz. See *Görz*.

Gorkum (properly *Gorinchem*), a fortified town of the Netherlands, on the Linge, at its junction with the Merwede, the name given for a short distance to the river formed by the union of the Waal and the Maas, 22 miles E.S.E. of Rotterdam. Pop. 12,053.

Gorky (pseudonym of *Alexei Maximovitsh Pyeshkov*), Russian author, born at Nijni-Novgorod, at the house of his maternal grandfather the painter Kashirine, in 1868. He chose the name of Gorky (meaning 'bitter' in Russian) on account of the hardships he had to endure in his early life. Left an orphan at the age of five, he received a few months' schooling, and was apprenticed by his grandfather to a shoemaker when he was nine years old. He then worked for a draughtsman, and for an ikon painter, and subsequently tried his hand at many things and served in many employments, from that of a cook's assistant on a Volga steamer to that of a lawyer's clerk. At the age of sixteen he came to Kazan, but, unable to enter any educational institution, he continued to work, never remaining more than a few weeks in any occupation. Of a roving disposition, he travelled over a large part of his native country as a tramp and mixed with the lowest of the population. The varied scenes and persons which he saw in this his vagabond life furnished him with the material for his literary work. Someone suggested to him the idea of writing, and he produced the story *Makar Tshudra*, which appeared at Tiflis in 1892 in the paper *Kavkaz*. He then began to write sketches for various papers in the Volga district. In 1893 he made the acquaintance of the Russian author Korolenko, who encouraged him to write, and placed his story *Tshelkash* in the *Rousskoe Bogatstvo*. Henceforth Gorky continued his literary work, describing the outcasts and vagabonds, and interpreting their suffering and misery. In a short time he became very popular and looked

upon as one of Russia's best authors. Gorky is a realist, and his realism is tinged with pessimism. His characters are all in conflict with society, and rebel against the existing order of things. Since 1898 Gorky's works appeared exclusively in the Petrograd periodical *Zhizn* (Life). Among his other works are: *Foma Gordyeev* (1889); *Mushik* (1900); *Three of Them* (1902); *Malva, Mother* (1907); *The Spy* (1908); *A Confession* (1910). His play *The Lower Depths* was produced in London in 1903. A collection of his works was published by the publishing society Znanie. A revolutionary since his early youth, Gorky was imprisoned several times under the autocratic régime. At the outbreak of the European War he enlisted and served with the Russian Red Cross. After the Russian Revolution of 1917 he joined the ranks of the Bolsheviks, and was a member of the Soviet of Petrograd, but in 1920 he definitely declared himself an opponent of the Bolshevik régime.—BIBLIOGRAPHY: P. Kropotkin, *Russian Literature*; E. J. Dillon, *Maxim Gorky: his Life and Writings*; A. S. Rappoport, *Gorky and Dostoevsky* (in *Twentieth Century Russia*, 1915); S. Persky, *Contemporary Russian Novelists*.

Görlitz (geur'lits), a town of Prussia, province of Silesia, on the left bank of the Neisse. It is well built, having generally substantial houses, several large squares and spacious streets. Its industries include woollens, linens, and cottons, machinery, iron-founding, glass, porcelain, leather, and soap. The town was an important place for three centuries before the Reformation; it afterwards declined, but has rapidly increased in prosperity since the laying down of the railways; the population, which in 1831 was only 8000, was, in 1919, 80,332. Founded about 1200, Görlitz passed to Saxony in 1635, and was annexed by Prussia in 1815.

Görres (geur'res), Jakob Joseph von, a distinguished German publicist and author, born at Coblenz 1776, died at Munich 1848. He began life with very advanced ideas, but ultimately his republican views became much modified, and he ended as an uncompromising Ultramontane Roman Catholic. He taught in a school at Coblenz, and having studied Persian, he produced a translation of part of the *Shah-nameh*. In 1814 he started the *Rheinische Merkur*, the organ of the German national movement against Napoleon, but it was suppressed in 1816 as obnoxious to the Prussian Government. In 1826 he became professor of history at Munich. Among his chief works are: *Aphorisms on Art, Faith and Science*, *Mythological History of Asia*, and *Christian Mysticism*.

Gorst, Sir John Eldon, British politician, born at Preston 24th May, 1835, died 1916. Educated at St. John's College, Cambridge, he was called

to the Bar in 1865, and entered the House of Commons in 1866 for the borough of Cambridge. He afterwards sat for Chatham and for Cambridge University (1892–1906). He was in succession Solicitor-General, Under-Secretary for India, Financial Secretary to the Treasury, and vice-president of the Committee of the Council on Education. An authority on social and labour questions, he was British plenipotentiary at the Labour Conference in Berlin in 1890.

Gorton, an urban district in Lancashire, and now included in Manchester, and giving name to one of its parliamentary divisions. One of the Manchester water-reservoirs is at Gorton. Pop. in 1911, 40,578.

Gortschakov, Alexander Michaelovitch, Russian diplomatist, brother of Prince Michael, was born 1798, died 1883. He entered the diplomatic service in 1824 as secretary to the Russian embassy in London. His experience in diplomacy was extended in Vienna, Florence, and Stuttgart, and he showed considerable dexterity in securing the neutrality of Austria during the Crimean War. In 1856 he became Minister of Foreign Affairs, and in 1862 Chancellor of the Empire. He was a prominent member of the Berlin Congress, 1878.

Gortschakov, Prince Michael, Russian general, born in 1792, died 1861. He took part as an artillery officer in the battle of Borodino in 1812, and served in the subsequent campaigns of the Allies against the French. He took a prominent part in the Turkish War (1828–9); the Polish War (1831); the invasion of Hungary (1849); and in the war with Turkey and the Western Powers (1853–5). In the Crimea he held the command in Sebastopol during the siege. After the war he was made Governor of Poland.

Görz, or **Görzitz** (geurts, geur'its; It. *Gorizia*, Slov. *Gorica*), a town of Italy, capital of the former Austrian province of Görz and Gradisca, near the head of the Adriatic, 23 miles N.N.W. of Trieste. It occupies a very picturesque site on a mountain slope, and consists of the high town, surrounded by walls and defended by an old castle; the new town, situated in the plain on the left bank of the River Isonzo; and several suburbs. Görz is the seat of an archbishop, and manufactures silk, cotton, leather, and earthenware. Charles X of France died there in 1836. The town was captured from the Austrians in Aug., 1916, and retaken in Oct., 1917. Pop. 30,995.

Goschen (gō'shen), George Joachim, Viscount, politician and financier, of German extraction, born in London 1831, died in 1907. Educated at Rugby and Oxford, he entered Parliament in 1863. In 1865 he was sworn of the Privy Council on becoming a member of the Russell

ministry. In 1868 he became President of the Poor Law Board, and subsequently First Lord of the Admiralty. On several occasions he found himself unable to move with the Liberal party; and when in 1886 Gladstone launched his Home Rule scheme for Ireland, Goschen became one of the leaders of the Liberal-Unionists. The same year he succeeded Lord R. Churchill as Chancellor of the Exchequer under Lord Salisbury, and in 1895 he again took office under the same leader as First Lord of the Admiralty. In 1900 he was raised to the peerage as Viscount Goschen. He was author of a well-known work on the *Theory of Foreign Exchanges*.

Gosforth, an urban district of England, in Northumberland, 2½ miles north of Newcastle, with many residences of Newcastle merchants. Pop. 15,719.

Goshawk, a diurnal bird of prey of the hawk kind, belonging to the genus *Astur* (*A. palumbarius*). The general colour of the plumage is a deep brown, the breast and belly white. A full-grown female is 23 or 24 inches in length, the male a good deal smaller. It was formerly much used in falconry. This bird flies low, and pursues its prey in a line after it, or in the manner called 'raking' by falconers. The female was generally flown by falconers at rabbits, hares, &c., and the larger winged game, while the male was usually flown at the smaller birds, and principally at partridges.

Goshen, in ancient geography, a district of Egypt, which Joseph procured for his father and brethren. The land of Goshen was supposed to be between the eastern part of the ancient Delta and the western border of Palestine.

Goslar, an interesting old town of Prussia in Hanover, 26 miles south-east of Hildesheim, on the north side of the Harz, at the foot of the Rammelsberg. It once ranked as a free imperial city, has remains of its old fortifications, and some old buildings, including part of a palace of the German Emperors, dating from the eleventh century, and containing an imperial throne dating from the twelfth century. There is also a town house of the fifteenth century. The inhabitants are chiefly engaged in the copper, silver, and other mines in the neighbourhood. Pop. 18,900.

Gospel, or **Gospels**. The Greek word for which *gospel* has been used as the equivalent is *evangelion*, or rather *euangelion*, a good or joyful message. In the New Testament it denotes primarily the glad tidings respecting the Messiah and his kingdom—this was emphatically the *gospel* (O.E., *gôdspell*, good tidings). It was quite naturally employed as a common title for the historical accounts which record the facts that constitute the basis of Christianity. It may be fairly said that the

genuineness of the four narratives written by Matthew, Mark, Luke, and John rests upon better evidence than that of any other ancient writings. They were all composed in the latter half of the first century; those of Matthew and Mark some years before the destruction of Jerusalem; that of Luke about the year 64; and that of St. John about the close of the century. Before the end of the second century we have abundant evidence that the four Gospels, as one collection, were generally used and accepted. While the early existence of these Gospels has been admitted, much discussion has taken place regarding their origin, and their relation one to another. They seem to have been viewed as so many original and independent sources, each one as much so as the others. The critical spirit of modern times has refused to halt at this point; it has sought to get at, so to speak, the genealogy of the several Gospels with their different degrees of relationship. Each of the four Gospels has in turn been assumed by different critics to be the first out of which the others arose. This view is known as the *Successive Dependence Theory*. Another theory, known as the *Documentary Theory*, and propounded by Le Clerc (1716), Priestley (1777), and Lessing (1778), maintains that some prior, more strictly original document, no longer extant, formed the common basis of all the Gospels. The supposition of an original document from which the three synoptical Gospels (those of Matthew, Mark, and Luke) were drawn, each with more or less modification, would naturally occur to those who rejected the notion that the evangelists copied from each other. The fourth Gospel, as the narrative coincides with that of the other three in a few passages only, is not drawn into the discussion, and the received explanation is the only satisfactory one with respect to it, namely, that John, writing last, had seen the other Gospels, and purposely abstained from writing anew what had been sufficiently recorded. Another conjecture is that the Gospels sprang out of a common oral tradition. This view is called the *Oral Theory*, and was suggested by Herder and Gieseler. According to this view of the origin of the Gospels, that of Mark, if not the oldest in composition, is yet probably the most direct and primitive in form; it is the testimony delivered by Peter, possibly with little alteration. The Gospels of Matthew and Luke, again, "represent the two great types of recension to which it may be supposed that the simple narrative was subjected. Luke represents the Hellenic, and Matthew the later Hebraic form of the tradition, and in its present shape the latter seems to give the last authentic record of the primitive Gospel." A comparison of the

three synoptical Gospels yields some interesting results. If we suppose the history they contain to be divided into sections, in forty-two of these all the three narratives coincide; twelve more are given by Matthew and Mark only, five by Mark and Luke only, and fourteen by Matthew and Luke. To these must be added five peculiar to Matthew, two to Mark, and nine to Luke. But this applies only to general coincidence as to the facts narrated; the number of passages either verbally the same, or coinciding in the use of many of the same words, is much smaller. Briefly stated, the critical result is as follows: There is a singular coincidence in substance in the three synoptical Gospels. The verbal and material agreement is such as does not occur in any other authors who have written independently of one another. The agreement would be no difficulty without the differences; it would only mark the one divine source from which they were all derived. The difference of form and style, without the agreement, would offer no difficulty, since there may be a substantial harmony between accounts that differ greatly in mode of expression, and the very difference might be a guarantee of independence. Several biographies of Jesus and the holy family written by unknown authors of the second, third, and later centuries are known as *Apocryphal Gospels*. They have no historical nor doctrinal value whatever. The titles of the best known of these are: *The Gospel of James*, *The Gospel of Joseph the Carpenter*, *The Gospel of Thomas*, *The Gospel of Nicodemus*, *The Acts of Pilate*, and his *Letter to Tiberias*.—BIBLIOGRAPHY: B. F. Westcott, *Introduction to the Study of the Gospels*; A. Wright, *The Composition of the Four Gospels*; F. C. Burkitt, *The Gospel History and its Transmission*; J. Drummond, *The Character and Authorship of the Fourth Gospel*; B. W. Bacon, *The Beginnings of Gospel Story*.

Gosport (God's port), a town and fortified seaport, England, county of Hants, on the west side of the entrance to Portsmouth harbour, and directly opposite the town of Portsmouth. Besides containing infantry barracks, it is an important naval depot, including a victualling yard, large Government factories, and Haslar Hospital (1746), the chief establishment in Britain for invalided sailors. Pop. (urban district, Gosport and Alverstoke), 33,588.

Gos'samer (probably a corruption of 'goose-summer') is the name of a fine filmy substance, like cobweb, which is seen to float in the air in clear days in autumn, and to a less extent in spring, and is most observable in stubble-fields, and upon furze and other low bushes. This is formed by young spiders of many species as a means of migration.

Gosse, Edmund, author, son of Philip Henry Gosse, born in London 1840; became library assistant in the British Museum 1867, was translator to the Board of Trade from 1875 to 1904; librarian to the House of Lords from 1904 to 1914. He has published *Northern Studies*; and has written much in the way of criticism, biography, and the history of English literature; besides several volumes of poetry. He was Clark lecturer in English literature at Trinity College, Cambridge, from 1884 to 1890. His works include: *History of Eighteenth Century Literature*, *History of Modern English Literature*, *Collected Essays*, *The Life of Swinburne*, *Inter Arma*, *Three French Moralists*, *Diversions of a Man of Letters*, and *Malherbe*. He was made a Companion of the Bath in 1912.

Gosse, Philip Henry, naturalist, born at Worcester 1810, died 1888. From 1827 to 1835 he was resident in Newfoundland, and afterwards travelled through Canada and the United States, making all the time large collections of insects. In 1844 he visited Jamaica. Among his many works are: *The Canadian Naturalist*, *The Birds of Jamaica*, *A Naturalist's Sojourn in Jamaica*, *The Aquarium*, *Marine Zoology*, *Life*, *Actinologia Britannica*, *Romance of Natural History*, besides many contributions to the publications of learned societies. His *Life* was written by his son, Edmund Gosse.

Gossypium. See *Cotton*.

Gotha (gō'tà), a town of Germany, capital of the former Duchy of Saxe-Coburg-Gotha, since Dec., 1919, in the Thuringian Republic. It is situated on the Leine, 14 miles w.s.w. of Erfurt, is well built, with fine environs and suburbs. The principal building is the palace, occupying the crown of the height on which the town is situated. It contains a museum, a picture-gallery, a valuable cabinet of engravings, a library of 200,000 vols. and 7000 MSS., of which 2500 are Arabic and 400 Persian and Turkish; and a collection of over 80,000 coins and medals. The manufactures consist chiefly of woollen, linen, and cotton tissues, porcelain, musical instruments, and articles in gold and silver. Pop. 39,553. See *Saxe-Coburg-Gotha*; *Thuringia*.

Gotham, a parish and village in county and 7 miles s.w. of Nottingham. It has an old reputation for folly, similar to that of the people of Abdera in Thrace, but the stories told of the 'wise men of Gotham' are widespread. *The Merrie Tales of the Mad Men of Gotham* were first collected and printed in 1550. Washington Irving, in his *Salmagundi*, applied the name to New York.

Gothard, St., a mountain group, Switzerland, on the confines of the cantons of Tessin and Uri, belonging to the Lepontine or Helvetic Alps, which it connects with the Bernese Alps. It

forms a kind of central nucleus in the great water-shed of Europe. Its culminating point has a height of 10,600 feet. The Col of St. Gothard, at its summit level, where the Hospice stands, is 6808 feet high. Over it an excellent carriage road was completed in 1832. A railway tunnel has been pierced through this mountain group between Göschenen on the north and Airolo on the south, thus directly connecting the railway system of North Italy with those of Switzerland and Western and Central Germany. This tunnel is the second longest in the world, its total length being 16,295 yards, or rather more than $9\frac{1}{4}$ miles. Its construction, begun in 1872, was completed in 1881, and it was opened for traffic early in 1882. Its total cost was about £2,400,000.

Gothic Architecture, a term applied to the various styles of Pointed architecture prevalent in Western Europe from the middle of the twelfth century to the revival of classic architecture in the sixteenth. The term was originally applied in a depreciatory sense to all the styles which were introduced by the barbarians who overthrew the Roman Empire. But the invention or introduction of the pointed arch gave birth to a new style of architecture, to which the name Gothic is now properly restricted. The chief characteristics of Gothic architecture are: the predominance of the pointed arch and the subserviency and subordination of all the other parts to this chief feature; the tendency through the whole composition to the predominance and prolongation of vertical lines; the absence of the column and entablature of classic architecture, of square edges and rectangular surfaces, and the substitution of clustered shafts, contrasted surfaces, and members multiplied in rich variety. This style originated in France and spread very rapidly to England, Germany, Italy, Spain, and the Scandinavian countries. In England it was introduced by William of Sens, who built Canterbury Cathedral in 1174, and here followed an independent course of development. The Gothic architecture of Britain has been divided into four principal epochs—the Early English, or general style of the thirteenth century; the Decorated, or style of the fourteenth century; the Perpendicular, practised during the fifteenth and early part of the sixteenth century (Flamboyant being the contemporary style in France); and the Tudor, or general style of the sixteenth century. From that time Gothic architecture declined in Britain, but a revival set in about 1825, and many fine specimens of Gothic have since been erected, chiefly ecclesiastical buildings. The several periods of Gothic architecture are clearly marked by the form and general treatment of the windows. Those of the Early English are of a

simple lancet form of elongated proportions, or of two or more lancet forms combined by mouldings. Those of the Decorated are broader in proportion, and with the upper part highly enriched with tracery of various curves and combinations. Those of the Perpendicular are frequently of very large size and still broader in proportion, while the upper part is also highly enriched. The enrichments invariably consist of a series of forms in which vertical lines prevail.



Gothic Architecture. Salisbury Cathedral

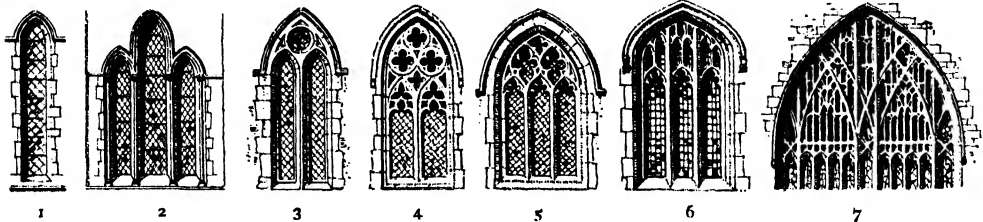
Between each of these styles there are transition periods in which the distinctions are less clearly marked. See also the separate terms.—**BIBLIOGRAPHY:** F. Bond, *Gothic Architecture in England*; A. Fairbairns, *Cathedrals of England and Wales*; Viollet-le-Duc, *Dictionnaire raisonné de l'architecture française*; Lübke, *Ecclesiastical Art in Germany during the Middle Ages*.

Göthite, a mineral iron hydroxide, $\text{FeO}(\text{OH})$, which may also be written as $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$, crystallizing in black lustrous prisms of the rhombic system. The colour of the powder is yellow-brown, like ordinary iron rust. Göthite seems to be the fundamental iron hydroxide in

nature, other and more common types, such as limonite, being derived from it by adsorption of various amounts of water.

Gothland, or **Gottland** (Sw. *Götaland*), one of the large sections into which Sweden was

the Baltic, and *Geats* or *Gauts* are known to us from the Old English poem *Beowulf* as inhabitants of Southern Sweden; but there is no necessary connection between these and the Goths proper. About the middle of the third century



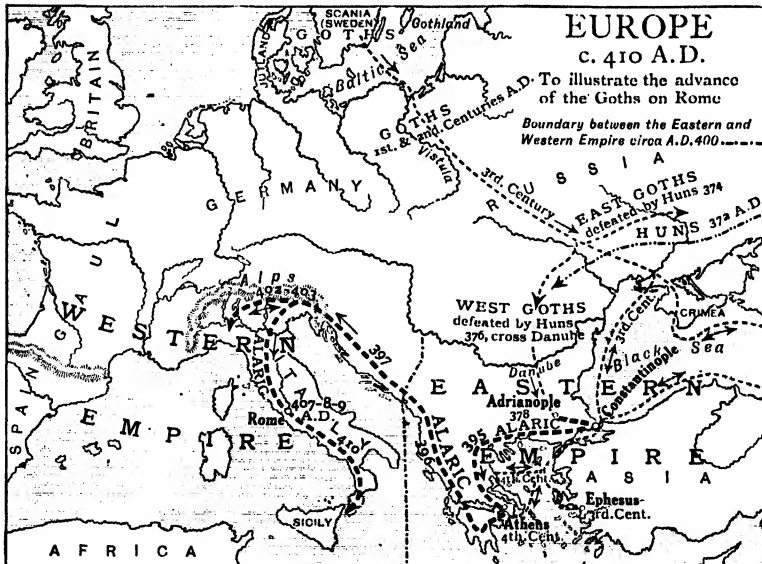
Gothic Architecture

1, 2, Early English windows. 3, Later Early English window, introduction of plate tracery. 4, Geometrical. 5, Decorated 6, Perpendicular. 7, Perpendicular tracery.

originally divided, and including the portion south of lat. $59^{\circ} 20' N$.

Gothlandian, or **Gotlandian**, a term proposed by De Lapparent in place of Upper Silurian, or Silurian as now commonly restricted, for the system of strata between the Ordovician

they began to encroach on the Roman Empire. Having seized the Roman province of Dacia, they were assailed by Decius, whom they twice defeated. In 253 they captured Trebizond, where a large fleet of ships fell into their hands. With this force they sailed down the *Ægean*



and the Devonian. From the Island of Gotland in the Baltic.

Goths, an ancient Germanic tribe occupying, when first known to history, the region adjacent to the Black Sea north of the Lower Danube. The historian Jordanes believes that they had a Scandinavian origin. A people of similar name is mentioned by Tacitus as dwelling south of

and plundered the coasts of Greece and Illyria. They now began to threaten Italy, but in 269 they were defeated with great slaughter by the Emperor Claudius. His successor Aurelian was, notwithstanding, compelled to cede to them the large province of Dacia, after which there was comparative peace between them for many years. In the fourth century the great Gothic

kingdom extended from the Don to the Theiss, and from the Black Sea to the Vistula and the Baltic. About the year 369 internal commotions produced the division of the Gothic kingdom into the kingdom of the Ostrogoths (eastern Goths) and the kingdom of the Visigoths (western Goths). In 395 Alaric, King of the Visigoths, made an irruption into Greece, laid waste the Peloponnesus, and became prefect of Illyria. He invaded Italy and sacked Rome in 409, and a second time in 410. After his death (in 410) the Visigoths succeeded in establishing a new kingdom in the southern parts of Gaul and Spain, of which, towards the end of the fifth century, Provence, Languedoc, and Catalonia were the principal provinces, and Toulouse the seat of government. The last king, Roderick, died in 711 in battle against the Moors, who had crossed from Africa, and subsequently conquered the Gothic kingdom. After the fall of the Western Roman Empire, by the invasion of Odoacer in 476, the Eastern emperor, Zeno, persuaded Theodoric, King of the Ostrogoths, to invade Italy in 489. The Goth became King of Italy in 493, and laid the foundation of a new Ostrogothic kingdom, which, together with Italy, comprised Rhaetia (a part of Switzerland and the Tyrol), Vindelicia (part of Bavaria and Swabia), Noricum (Salzburg, Styria, Carinthia, Austria), Dalmatia, Pannonia (Further Hungary, Slavonia), and Dacia beyond the Danube (Transylvania, Wallachia). This kingdom came to an end in 554. Subsequently the Goths both here and in Spain entirely disappeared as a distinct people.

Christianity appears to have early taken root among the Goths settled in Moesia, a Gothic bishop being mentioned as present at the Council of Nicæa (325). Their form of Christianity was Arianism, which was patronized by their protector, Valens, and certainly adopted by their bishop, Ulfilas. The introduction of Christianity among the Goths, and the circumstances of their dwelling near, and even among, civilized subjects of the Roman Empire, greatly contributed to raising them in civilization above the other German tribes. Bishop Ulfilas, in the fourth century, translated, if not the whole, at least the greater part of the Bible into Mosco-Gothic, using an alphabet which he formed out of those of the Greeks and Romans. Unfortunately only a small portion of this translation has come down to us; but this is quite sufficient to enable us to form an opinion of the language at that time, and is of the highest value from a philological point of view. Besides this translation there exist a few other monuments of the language, which are, however, of minor importance. Gothic was one of the Teutonic tongues, being accordingly a sister of Old and Modern English,

German, Dutch, and Danish. Being committed to writing earlier than any other Teutonic language, Gothic exhibits peculiarities entirely its own, and hence its value in the study of Teutonic philology in general. It is richer in inflections than any other of the Teutonic tongues. Swedish is the least like the Gothic of all the Germanic dialects, and notwithstanding the name *Gothland* (q.v.), there is no evidence to show that the Goths ever formed part of the population of Scandinavia. See *Ulfilas*.—BIBLIOGRAPHY: E. Gibbon, *Decline and Fall*; T. Hodgkin, *Italy and her Invaders*; J. B. Bury, *History of the Later Roman Empire*; J. Wright, *Primer of the Gothic Language*; Prof. Skeat, *Moeso-Gothic Glossary*; Martroye, *L'Occident à l'Époque Byzantine: Goths et Vandales*.

Gottenburg, or **Gothenburg** (Sw. *Göteborg*), a seaport town in Sweden, the second in respect of population and trade, capital of the *län* of the same name, situated at the mouth of the Göta, in the Cattegat, 255 miles w.s.w. of Stockholm, intersected by canals. It is one of the best-built towns in Sweden, and the seat of a bishopric. It has manufactures of sail-cloth, cotton, and other goods, and possesses ship-building yards, tobacco factories, breweries, and sugar refineries. The trade is very extensive, the harbour being excellent and always free from ice. It has a good depth of water, is defended by forts, and there is a dry dock cut in the solid rock. The completion of the Göta canal and railway facilities increased its importance. Among social reformers the town is noted for its licensing system, under which the public-house licences are granted to a company, which, after paying the expenses of management with 6 per cent annual interest on the shareholders' capital, makes over the profits to the town treasury. The Gothenburg system has been in force since 1865, and with variations has been widely adopted in Sweden, Norway, and Finland.

Göttingen (geut'ing-en), a town of Prussia, province of Hanover, on the Leine, 59 miles s.s.e. of Hanover. It is a place of great antiquity, and is generally well built, having wide and spacious streets. Its chief attraction is the university, founded in 1734 by George II of England and Elector of Hanover, opened in 1737. It has an average attendance of some 1500 students. Connected with the university are a museum, an observatory, an anatomical theatre, botanical garden, and a library possessed of 500,000 printed volumes and 5000 MSS. The manufactures comprise woollens, chemicals, and scientific instruments. Pop. 37,594.

Gottland, or **Gothland**, an island of the Baltic, belonging to and about 45 miles east of the coast of Sweden. It is of irregular shape,

and has an area of 1176 sq. miles. The coast is for the most part rocky and deeply indented. The interior consists of a limestone plateau, intersected near its centre by a range of heights from 200 to 300 feet above the sea. The soil is fertile. The chief town, Wisby, was once a flourishing member of the Hanseatic League. Together with two adjacent islets, the Island of Gottland forms the Swedish *län* or government of the same name. Area of *län*, 1220. Pop. (1919), 55,982.

Gottsched (got'shet), Johann Christoph, German writer, born 1700, died 1766. He became professor of rhetoric and poetry, and afterwards of logic and metaphysics, at Leipzig; and for many years was dictator in Germany in matters of literary taste. In 1728 he published the first sketch of his *Rhetoric*, and in 1729 his *Kritische Dichtkunst* (Critical Art of Poetry). Both these works condemn the disfigurement of the language by the use of foreign words, and oppose the taste for bombast in poetry which then prevailed. In 1730 he published his *Contributions towards a Critical History of the German Language, Poetry, and Eloquence*, and subsequently his *Erste Gründe der Weltweisheit* (First Principles of Philosophy). By advocating French taste in literature as opposed to English, he lost within his lifetime much of the influence he had acquired earlier in his career.—Cf. T. W. Danzel, *Gottsched und seine Zeit*.

Gouda (gou'dà), a town of Holland, in the province of South Holland, 11 miles north-east of Rotterdam, separated into two unequal parts by the Gouwe, which here unites with the IJssel. The town, founded in 1485, burned down and rebuilt in 1552, is composed of neatly-built houses, and is intersected by numerous canals. The great market-place is the largest in Holland. The church of St. John (1485) is noted for its organ and its painted glass windows, said to be among the finest in Europe. There are pipe-works, potteries, and breweries, and manufactories of stearine candles, yarn, and cigars. Gouda is a great market for cheese, sold under the name of Gouda cheese. Pop. 29,704.

Goudimel (gō-di-mel), Claude, French musical composer, born 1510; killed during the St. Bartholomew massacres at Lyons, 1572. Palestrina was one of his pupils at Rome. His most important work is a setting of the French version of the *Psalms* by Marot and Beza. Some of these tunes are still used by the French Protestant Church and by the German Lutherans.

Gough (gof), Sir Hubert de la Poer, British soldier, born 12th Aug., 1870. He was educated at Eton and Sandhurst, joined the 16th Lancers in 1889, and served in the Tirah Expedition and in the South African War. He commanded his regiment from 1907 to 1911. During the

European War he held many responsible positions, being in command of the Fifth Army at the Third Battle of Ypres (July, 1917), and during the German advance at St. Quentin in March, 1918. He was created G.C.M.G. in 1919.

Gough, Hugh, Viscount, British soldier, born at Woodstown, County Limerick, 1779, died 1869. He joined the army in 1794, and was present the year after at the capture of the Cape of Good Hope. He served in Spain from 1809 to 1813; was made major-general in 1830, and sent to India as commander of the Mysore division of the army in 1837. He commanded the land forces in the Chinese War of 1841; was made baronet, and returned to India as commander-in-chief. He suppressed the revolt of the Mahrattas in 1843, commanded in the Sikh Wars of 1845-8, but was superseded by Sir Charles Napier in 1849. He was made baron in 1846; created viscount and pensioned, 1849; became field-marshal, 1862.

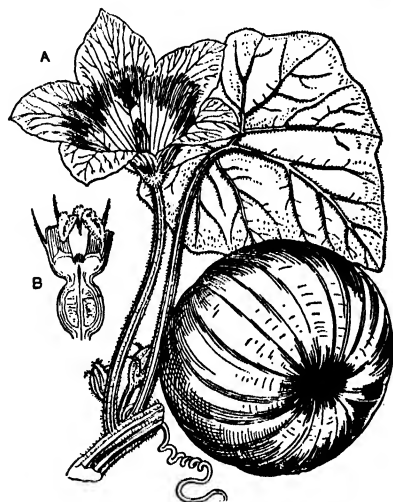
Goulburn (göl'bérn), a city of New South Wales, in Argyle County, 134 miles s.w. of Sydney, well laid out, with broad streets lined with substantial buildings. Among the more important of the public buildings are the Anglican and Roman Catholic cathedrals, several other churches, the court-house, and mechanics' institute. The industries include jam-factories, flour-mills, breweries, tanneries, and boot and shoe factories. Being the centre of several important railways, it is the principal depot of the southern inland trade. There are no gold-fields in the vicinity, but silver, copper, and other metals, marble, slate, and lime, are among the wealth of the quarter. Pop. (1919), 11,000.

Gounod (gō-nō), Charles François, French operatic composer, born at Paris 1818, died in 1893. He studied at the Conservatoire under Halévy, Lesueur, and Pauer, and afterwards in Italy. His first important work was *Faust* (1859), which raised him to a high rank among composers. Other operas followed, among which are *Mireille* (1864), *Romeo et Juliette*, *Cinq-Mars* (1877), and *Polyeucte* (1878). He wrote also a *Messe Solennelle*, a motet *Gallia*, and other choral works and songs; oratorios *Redemption* (1882), *Mors et Vita* (1885), and a Mass for the Jeanne d'Arc festival (1887).—Cf. H. Imbert, *Charles Gounod*.

Gourd (görd), the popular name for the species of *Cucurbita*, a genus of plants of the nat. ord. Cucurbitaceæ. The same name is given to the different kinds of fruit produced by the various plants of this genus. These are held in high estimation in hot countries; they attain a very large size, and most of them abound in wholesome, nutritious matter. The *C. Pepo*, or pumpkin, acquires sometimes a diameter of 2 feet. The *C. Melopepo*, or squash,

is cultivated in America as an article of food. The *C. Citrullus*, or water-melon, serves the Egyptians for meat, drink, and physic. The *C. aurantia*, or orange-fruited gourd, is cultivated only as a curiosity, and is a native of the East Indies. The *Lagenaria vulgaris*, or bottle gourd, a native both of the East and West Indies, is edible, and is often 6 feet long and 18 inches in circumference. The outer coat or rind serves for bottles and water-cups.

Gourock (gō'rok), a town of Renfrewshire, Scotland, on the Firth of Clyde, 2 miles west of Greenock. It is a favourite watering-place



Gourd (*Cucurbita Pepo*, or Pumpkin)

A, Male flower. B, Section of female flower.

and yachting station, and has a pier for steamers. Pop. 10,128.

Gout, a form of arthritis, a constitutional disorder giving rise to paroxysms of acute pain with a specific form of inflammation, appearing after puberty chiefly in the male sex, and returning after intervals. It is very often preceded by, or alternates with, disorder of the digestive or other internal organs, and is generally characterized by affection of the first joint of the great toe, by nocturnal exacerbations and morning remissions, and by vascular plethora; various joints, organs, or parts becoming affected after repeated attacks without passing into suppuration. It may be acquired or hereditary. In the former case it rarely appears before the age of thirty-five; in the latter, it is frequently observed earlier. It appears that the disease is due to an excess of uric acid in the blood, this either being formed in the body in too large quantity, or not being removed from the blood by the kidneys in the urine as it ought to be.

Indolence, inactivity, and too free use of tartareous wines, fermented liquors, and very high-seasoned and nitrogenous food are the principal causes which give rise to this disease. Gout is also called, according to the part it may affect, *Podagra* (in the feet), *Gonagra* (in the knees), *Chiragra* (in the hands), &c. It may be acute or chronic, and may give rise to concretions, which are chiefly composed of urate of soda. Strict regulation of the habits of life is one of the most important elements in the treatment of gout.

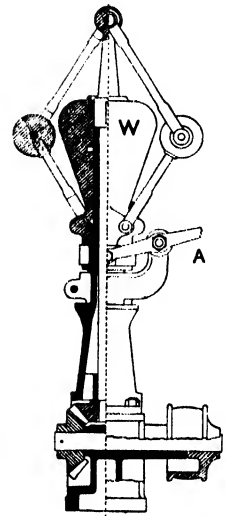
Gov'an, a burgh of Scotland, county of Lanark, on the left bank of the Clyde, to the west of Glasgow. It carries on shipbuilding and engineering. Since 1912 Govan is included within the municipal boundaries of Glasgow. It gives name to one of the fifteen parliamentary divisions of the city. Pop. (1911), 89,605.

Government is a word used in common speech in various significations. It denotes the act of governing, the persons who govern, and the mode or system according to which the sovereign powers of a nation, the legislative, executive, and judicial powers are vested and exercised. Aristotle divided the forms of government into three classes: first, Monarchy, or that form in which the sovereignty of the state is vested in one individual; second, Aristocracy, or that in which it is confided to a select portion of the community supposed to possess peculiar aptitude for its exercise; and third, Democracy, or that in which it is retained by the community itself, and exercised, either directly, as in the small republics of ancient Greece, or indirectly, by means of representative institutions, as in the constitutional states of modern times. Each of these forms, if brought into existence by the general will of the community, maintained by its consent, and employed for its benefit, is said to be a legitimate government. But each of these legitimate forms was considered by the ancients to be liable to a particular form of corruption. Monarchy had a tendency to degenerate into tyranny, or a government for the special benefit of the single ruler; aristocracy became oligarchy; and democracy degenerated into ochlocracy or mob rule. Through each of these various forms, each legitimate form being followed by its corresponding perverted form, government was supposed to run in a perpetual cycle; the last form, ochlocracy, being followed by anarchy. As a means of avoiding these evils, a mixed government is supposed to have been devised. The best species of mixed government was believed by Aristotle to be a union of aristocracy and democracy. The most remarkable instance of this form is, however, supposed to be seen in that balance of powers which forms the essence of the British Constitution. See *Aris-*

ocracy; Democracy; Monarchy; Oligarchy; Republic; Local Government; Soviets; &c.—BIBLIOGRAPHY: Machiavelli, *The Prince*; Locke, *Civil Government*; Montesquieu, *The Spirit of Laws*; J. S. Mill, *Liberty and Spiritual Government*; W. Bagehot, *The English Constitution*; A. L. Lowell, *The Government of England*; Lord Bryce, *The American Commonwealth*; B. Bosanquet, *Philosophic Theory of the State*; J. S. Mackenzie, *Introduction to Social Philosophy*; J. A. Hobson, *Towards International Government*; F. A. Ogg, *The Governments of Europe*.

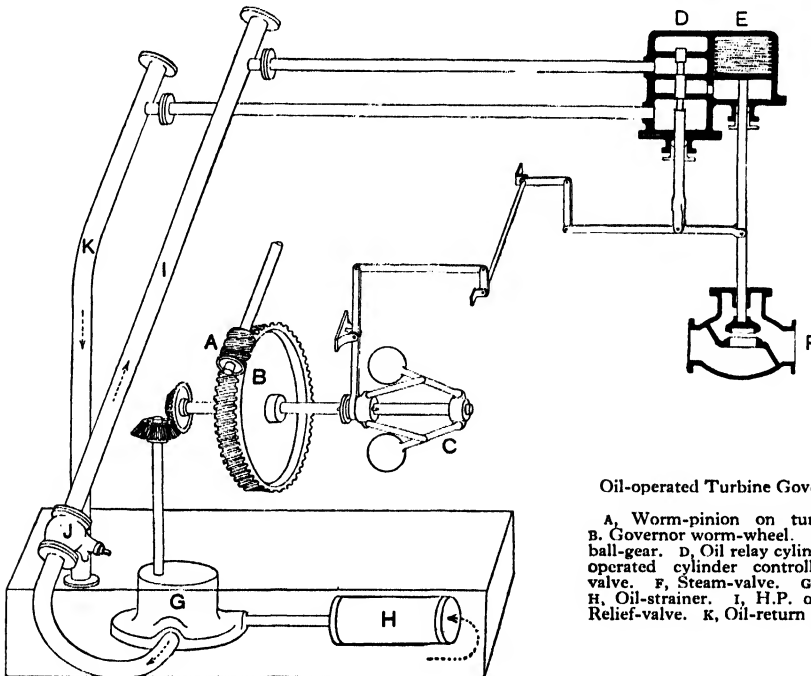
Governor, in engineering, a device for controlling the admission of steam to an engine or turbine. Most governors work on the principle of centrifugal force. If too much steam, say, is being admitted to a steam-engine, the speed of the engine rises, and the centrifugal forces in any rotating mechanism connected to it increase. The increased centrifugal forces are made to close the valve admitting the steam so that the speed falls. A Porter governor is shown in the diagram opposite. The balls are controlled by the conical cast-iron weight *w*. When the engine speed rises, the increased centrifugal force acting on the balls throws them outwards against the weight *w*. They therefore lift up the end of the rod *A*, which operates the admission-valve. When the valves are too large to be operated directly in this way, they are operated hydrauli-

cally by oil. The hydraulic power is controlled by a relay-valve, which is itself controlled by centrifugal force. The diagram below shows the Continental design of oil-governor for a turbine plant. Nearly all large turbine plants are fitted with a second main steam-valve, called the *emergency-valve*, which is held open against a powerful spring by means of a lever controlled by a trigger. At the end of the shaft a very simple centrifugal governor is provided, which consists of an eccentric weight controlled by a spring. If the speed of the machine exceeds a certain limit, this weight swings out far enough to trip the trigger and thereby close the emergency-valve. This is necessary for large power plants because of the great damage which



Porter Governor

A, Lever to steam-valve.
W, Weight controlling mechanism.



Oil-operated Turbine Governor Gear

A, Worm-pinion on turbine shaft.
B, Governor worm-wheel. C, Governor ball-gear. D, Oil relay cylinder. E, Oil-operated cylinder controlling steam-valve. F, Steam-valve. G, Oil-pump. H, Oil-strainer. I, H.P. oil-main. J, Relief-valve. K, Oil-return pipe.

would be done in the event of the ordinary governor gear failing to act, as it not infrequently does in spite of every care.—BIBLIOGRAPHY: D. A. Low, *Applied Mechanics*; H. M. Martin, *Steam Turbines*.

Gower, John, English poet, was born about 1330, and died in 1408. He is believed to have been of good family and independent means. He was a personal friend of Chaucer, who dedicated *Troilus and Criseide* to "moral Gower". In applying this epithet Chaucer had no intention of being offensive; he merely meant that Gower's writings were sententious. Gower is chiefly known on account of his three poems, *Speculum Meditantis*, written in French; *Vox Clamantis*, written in Latin; and *Confessio Amantis*, written in English. *Speculum Meditantis* was lost until 1895, when, for better or worse, it was discovered in the University Library at Cambridge. It is about 30,000 lines long, and consists of an elaborate allegory, introducing the seven deadly sins and the seven deadly virtues, and concluding with a life of the Virgin Mary. *Vox Clamantis* is written in Latin elegiac verse, the monotony of which is relieved by numerous false quantities. Part of it deals with the peasants' revolt of 1381. It is also full of dreary allegory. It contains a good many passages borrowed from Ovid, Alexander Neckam, and Peter de Riga; these passages were for long believed to be Gower's own work. The *Confessio Amantis* is Gower's masterpiece, and has the additional advantage of being written in English. It is highly allegorical also, but it contains a great many stories drawn from many sources. Gower, like Cerberus, was trilingual, but was unlike him in not being 'three gentlemen at once'. Gower is just the same whether he writes in French, Latin, or English; he can be tedious in all three languages. J. R. Lowell, in his essay on Chaucer, speaks of Gower, and does not let mercy season justice. He says that he has positively raised tediousness to the precision of science, and speaks of his rhyme being regularly pertinacious as the tick of an eight-day clock. "There is nothing beyond his power to disenchant, nothing out of which the tremendous hydraulic press of his allegory will not squeeze all feeling and freshness and leave it a juiceless pulp. Dip in at the middle or the end, dodge back to the beginning, the patient old man is there to take you by the button and go on with his imperturbable narrative. You may have left off with Clytemnestra, and you may begin again with Samson; it makes no odds, for you cannot tell one from t' other." Even death does not quite free us from the garrulous old man, for George Wilkins resurrected him to speak the prologues in *Pericles Prince of Tyre*. There is

on the face of it no reason why a poem written on the scheme adopted in *Confessio Amantis* should ever stop. It is 33,000 lines long, but like the work of a later and greater poet it

"might, ods bobs, sir, in judicious hands,
Extend from here to Mesopotamy".

To bracket Gower and Chaucer together, as was done by many early and some later critics, is even more absurd than to couple Jonson and Fletcher with Shakespeare. The men have really nothing in common, save that they were friends and contemporaries. Chaucer was a genius; Gower a man of no very great amount of talent. Gower's death did not eclipse the gaiety of nations; but his work helped to establish the standard literary language. For that he must have his meed of praise.—BIBLIOGRAPHY: H. Morley, *English Writers*; W. J. Courthope, *History of English Poetry*; W. P. Ker, *Essays on Medieval Literature*.

Gower, one of the seven parliamentary divisions of Glamorganshire. It is peninsular, forming the west part of the county. There are old ruins and remains supposed to be Druidical.

Gowrie Conspiracy, one of the strangest episodes in Scottish history, took place in Aug., 1600. King James VI, while hunting in Falkland Park, Fifeshire, was asked by Alexander Ruthven (brother of the Earl of Gowrie) to accompany him to Gowrie House, near Perth, on the pretext that they had caught a Jesuit with an urn of foreign golden pieces hidden under his cloak. On arriving at Gowrie House an attempt was made on the life or liberty of the king, but an alarm being raised, both the Ruthvens were slain, and James with difficulty escaped, as the Gowries were very popular with the inhabitants of Perth.—Cf. Andrew Lang, *James VI and the Gowrie Conspiracy*.

Goya'na, a city of Brazil, in the state of Pernambuco, 40 miles N.W. of the port of Recife or Pernambuco. Commerce in cotton, sugar, rum, hides, timber, castor-oil, &c. Pop. 13,000.

Goya y Lucientes, Francisco José de, Spanish painter and etcher, born in Aragon 1746, died in Bordeaux 1828. He first worked in Saragossa under José Martínez, but as the result of a street brawl had to go to Madrid, whence he went to Rome. In 1774 he returned to Spain, and in 1789 became court painter to Charles IV. In 1824 he went to Paris, and finally settled at Bordeaux. His work includes church decorations in Seville, Toledo, and Valencia; genre pictures of contemporary Spanish life; many portraits, notable among which are *The Duchess of Alba* and *Charles IV and his Family*; and a fine series of etchings. It is marked by great technical skill, a powerful and fantastic imagination, and a bitterly satirical

outlook. Goya has exercised great influence on modern European art, especially in France. He is best seen in Madrid, but he is represented in the National Gallery, and the British Museum has a good collection of his etchings.

Goyaz, an inland state of Brazil; area, 288,402 sq. miles. Chief town, Goyaz. The chief occupation of the inhabitants is cattle-rearing and agriculture. Gold was formerly plentiful, and diamonds and other precious stones have been found. Pop. (1920), 528,879. The chief town, formerly called Villa Boa, has a cathedral and Government palace. Pop. about 25,000.

Gozo, or **Gozzo**, an island of the Mediterranean, belonging to Britain, about 4 miles n.w. of Malta; length, 9 miles; breadth, 5 miles; area, about 26 sq. miles. A good deal of corn and fruit is raised; but the most important crop is cotton. Cattle of superior quality are reared. The chief town, Rabato, contains about 3000, and the whole island about 20,000 inhabitants.

Gozzi (got'sē), Carlo, Italian dramatist, born at Venice 1722, died 1806. His principal work consists of a series of dramas based on fairy tales, which obtained much popularity.

Gozzoli (got'so-lē), Benozzo, Italian painter, born at Florence 1420, died in 1498. He was a pupil of Fra Angelico, and worked at Florence, Rome, Orvieto, and Pisa. His name is specially identified with the great series of mural paintings in the Campo Santo, at Pisa, consisting of 24 subjects from the Old Testament, from *The Invention of Wine by Noah* to *The Visit of the Queen of Sheba to Solomon*. His *Virgin and Child Enthroned* is in the National Gallery, and *The Glory of St. Thomas Aquinas* in the Louvre.

Graaff-Reinet (gräf-rī'net), a town, Cape Province, capital of a division of the same name, the oldest and largest town in the midland district of the province. There are churches and schools of the English Episcopalian and the Dutch Reformed denominations, a public library, and a college. The town is regularly laid out with streets at right angles, the intervening squares being filled up with vineyards and gardens. Pop. 8129 (of whom in 1918, 3886 were white).

Graafian Vesicles or **Follicles**, in anatomy, numerous small globular transparent follicles found in the ovaries of mammals. Each follicle contains one ovum, which is expelled when it reaches maturity. Small at first, and deeply imbedded in the ovary, they gradually approach the surface, and finally burst and discharge the ovum. They provide the mechanism for extruding ripe ova from the solid ovary; but the walls of the follicles are glands of internal secretion, forming hormones which determine the development of the secondary sexual characters and the secretion of milk.

Gracchus, a Roman family of the Sempronian gens, several members of which have become celebrated. *Tiberius Sempronius Gracchus*, a general of the Second Punic War, was consul 215 B.C., defeated Hanno 214 B.C., and was killed 212 B.C.—Another *Tiberius Sempronius Gracchus* became consul 178 B.C., and again 163 B.C. He married Cornelia, a daughter of Scipio Africanus, and was the father of the two most celebrated Gracchi, *Tiberius Sempronius* and *Gaius*, the former born about 169 B.C., killed 133 B.C.; the latter born 159 B.C., killed 121 B.C. The brothers, having lost their father early, received from their mother Cornelia a careful education. At a more advanced age their minds were formed and ennobled by the Greek philosophy. Tiberius early made himself conspicuous by his military service. Under the command of his brother-in-law, the younger Scipio, he served at the siege of Carthage. While he was yet a mere youth he was received into the College of Augurs—an honour usually conferred only upon distinguished statesmen. He was subsequently quaestor to the Consul Mancinus, and was employed in the Numantine War, in which he greatly distinguished himself by the conclusion of a treaty by which he saved the lives of 20,000 men who were entirely at the mercy of the Numantines. This treaty was, however, repudiated by the Romans, but it increased his popularity immensely. In 133 B.C. he offered himself as a candidate for the tribuneship, which office rendered his person inviolable so long as he was invested with it, and placed him in a situation to advance his great plans for the improvement of the condition of the people in a legal way. His first efforts were directed to a reform of the Roman land system, by the restoration or enforcement of the old Licinian law, which enacted that no one should possess more than 500 acres of the public domains, and that the overplus should be equally divided among the plebeians. This law, which was now called, after Gracchus, the *Sempronian*, or the *Agrarian law*, he revived, but with the introduction of several softening clauses. He was violently opposed by the aristocracy and the tribune Marcus Octavius, whose veto retarded the passage of the Bill. Tiberius, however, by exerting all the prerogative of his office, managed to pass his bill, and three commissioners were appointed to carry it into execution, namely, Tiberius himself, his brother Gaius, and his father-in-law Appius Claudius. Soon after this Attalus, King of Pergamus, died, bequeathing his treasures to the Roman people. Tiberius proposed that this bequest should be divided among the recipients of land under the new law, and to give the popular Assembly instead of the Senate

the management of the State. But fortune turned against him; he was accused of having violated his office, and of aspiring to be king; and at the next election for the tribuneship he was slain, with 300 of his followers, at the entrance to the Temple of Fides. Ten years after the death of his brother Tiberius, the younger Gracchus obtained the tribuneship. In the discharge of his office he first of all renewed his brother's law, and avenged his memory by expelling many of his most violent enemies from the city. Several popular measures gained him great favour with the people, but the intrigues of the nobles ultimately caused his fall. Livius Drusus, a tribune gained over to their interests, had the art to withdraw the affections of the populace from Gaius by making greater promises to them, and thus obtained a superior popularity for himself and the Senate. Hence it resulted that Gaius did not obtain a third tribuneship, and Opimius, one of his bitterest enemies, was chosen to the consulate. A tumult, in which a lictor of Opimius was killed, gave the Senate a pretence for empowering the consuls to take strong measures. Opimius made an attack upon the supporters of Gracchus with a band of disciplined soldiers. Nearly 3000 were slain, and Gracchus escaped to the grove of the Furies, where he was slain at his own request by a slave, who then killed himself.—BIBLIOGRAPHY: Beesly, *The Gracchi, Marius and Sulla*; Sir C. W. C. Oman, *Seven Roman Statesmen of the Later Republic*; A. H. J. Greenidge, *History of Rome*.

Grace, in theology, the divine influence or the influence of the Holy Spirit in renewing the heart and restraining from sin; or, that supernatural gift to man whereby he is enabled to take to himself the salvation provided and offered through Christ (special or saving grace). Before the fifth century little attention was paid to the dogmatic question of grace and its effects. Pelagius, a native of Britain, having used some free expressions, which seemed to attribute too little to the assistance of divine grace in the renovation of the heart of man, and too much to his own ability to do good, Augustine undertook an accurate investigation of this doctrine. He came to the opinion, which has since been so much discussed, that God, of His own free will, has foreordained some to eternal felicity and others to irrevocable and eternal misery. In accordance with this view of Augustine is the doctrine of predestination. The majority of those who were considered Catholic or Orthodox coincided with Augustine, and, with him, pronounced the Pelagians heretics, for holding that human nature is still as pure as it was at its first creation, that all the corruption which prevails is the effect of the

influence of bad example, and that, consequently, man, being sufficient for his own purification, has no need, at least, of preventing grace. The Abbot Cassianus, of Marseilles, adopted a middle course, in order to reconcile the operations of grace and free-will in man's renovation, by a milder and more scriptural mode. He considered the predestination of God, in respect to man's salvation, as a conditional one, resting upon his own conduct. His followers were named *semi-* or *half-Pelagians*, though the Catholic Church did not immediately declare them heretics. Subsequently a gradual change of sides was exhibited. During the Middle Ages the scholastic theologians so perverted the doctrines of Augustine as to make them easily reconcilable with those of the Pelagians. But at the Reformation Calvin and Beza, and the great body of their followers, returned to the fundamental principles of Augustine. In the meantime, however, the Catholics had not come to a final agreement concerning this dogma. This appears from the quarrels of the Dominicans and Jesuits, and from the case of the Jesuit Luis Molina, in 1588, from whom the Molinistic disputes in the Netherlands received their name. In the seventeenth century, also, two new parties, which had their origin in the dispute concerning the doctrine of predestination, sprang up in the Netherlands, namely, the Arminians or Remonstrants among the Protestants, and the Jansenists among the Catholics. (See *Arminians*; *Jansenists*). From that time the members of the Christian Church have continued to differ upon this subject.—BIBLIOGRAPHY: A. Harnack, *History of Dogma*; H. W. Robinson, *Christian Doctrine of Man*.

Grace, **Days of**, in commerce, a certain number of days immediately following the day, specified on the face of a bill or note, on which it becomes due. Till the expiry of these days payment is not necessary. In Britain and America the days of grace are three. Austria (three days) and Russia (ten days) are the only other countries which allow days of grace. The number of days of grace depends on the law of the place where the bill is payable, not of that where it is drawn or indorsed.

Grace, William Gilbert, famous cricketer, was born at Downend, Gloucestershire, in 1848, died 23rd Oct., 1915. Educated privately, he entered the medical profession and practised in Bristol for twenty years, 1879-99. He was a member of the Royal College of Surgeons of England and a licentiate of the Royal College of Physicians of Edinburgh. In 1864 he made his first appearance in a leading cricket match at the Kennington Oval, Surrey's famous ground, and from 1870 to 1900 he played in the Gloucestershire county eleven. From 1899 he was secretary

and general manager of the London County Cricket Club. His greatest achievements were accomplished with the bat, but he was a master of all departments of the game. His publications comprise: *Cricket* (1891), *Cricketing Reminiscences and Personal Recollections* (1899), and *W. G.'s Little Book* (1909).

Graces (Gr. *Charites*, translated by the Romans *Gratiæ*), the goddesses of grace, from whom, according to Pindar, comes everything beautiful and agreeable. According to most poets and mythologists they were three in number, the daughters of Zeus and Eurynöme, and Hesiod gives them the names of *Aglaiä* (brilliancy), *Thalia* (the blooming), and *Euphrosynë* (mirth). Homer mentions them in the *Iliad* as handmaids of Hera (Juno), but in the *Odyssey* as those of Aphrodītē (Venus), who is attended by them in the bath, &c. He conceived them as forming a numerous troop of goddesses, whose office it was to render happy the days of the immortals. The three graces are usually represented slightly draped or entirely nude, locked in each other's embrace, or hand in hand.

Gracilaria, a genus of Red Algae. *G. lichenoides*, the 'Ceylon Moss' of the Indian Ocean, is one of the sources of the gelatinous substance called 'agar-agar', largely used for preparing solid culture media in bacteriology, &c.

Gracio'sa, one of the Azores. Chief town, Santa Cruz. Pop. 8000.

Gradient, in mathematics, physics, engineering, and surveying, is a number measuring the slope of an inclined line relative to a horizontal plane. It may be measured either by the angle of inclination of the line to the plane, or by the sine or the tangent of the angle of inclination. In surveying and engineering the gradient is usually measured by the tangent of the angle of inclination expressed in the form 1 in x ; thus the gradient of 1 in 20 means that the sloping line makes an angle with the horizontal plane whose tangent is $\frac{1}{20}$. In America a gradient is expressed as a percentage; thus a gradient of 1 in 20 is described as a 5 per cent grade. The heaviest gradients encountered in ordinary railway work are gradients of about 1 in 20. For steeper gradients, rack railways, or rope railways, are used. Some of the Alpine rack railways have gradients of 25 per cent.

Gradisca, a town and district of Italy, formerly belonging to Austria-Hungary. The town of Gradisca is situated on the right bank of the Isonzo, about 30 miles north-west of Trieste. Captured by the Italians in 1915, but retaken by the Austrians, it was again captured by the Italians in 1918. Pop. of district, 34,155.

Grad'ual, the psalm, anthem, or hymn, said or sung in the service of the Roman Catholic

Church between the Epistle and the Gospel; so named from being anciently chanted on the steps of the ambo or pulpit, or of the altar. By an easy transition the name was frequently applied to the *Antiphonary*, which was originally one of the three service books of the Church, but afterwards in the eleventh or twelfth century included in the missal.

Graduation, the art of dividing into the necessary spaces the scales of mathematical, astronomical, and other physical instruments. Original graduation is chiefly performed either by *stepping* or *bisection*.

Stepping consists in ascertaining by repeated trial with finely-pointed spring dividers the size of the divisions required, and then marking them.

In bisection an arc of radius nearly half the line is described from each end of the line by means of the beam compass, and the short distance between the arcs is bisected with the aid of a magnifier and fine pointer. This division is repeated for each of the two halves thus obtained until the required graduation is obtained. The original scale can henceforward be used as a pattern, and copies of it reproduced either by hand or machine.

If the copy be made by hand, the material which is to be divided must be placed parallel to the standard if the scale required is a linear one, or concentric with it if the scale be circular, and the divisions made by a dividing knife.

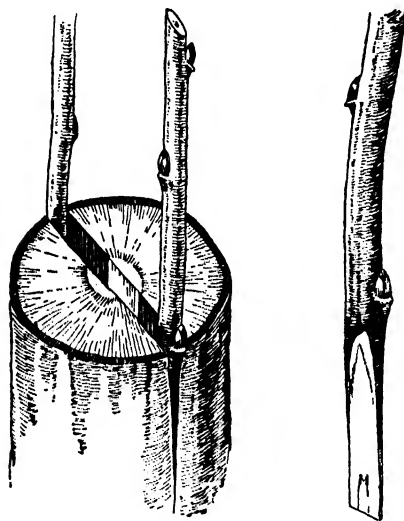
Linear and circular dividing engines have now replaced hand copying. These machines are constructed upon the principle of Ramsden's circular machine, invented in 1766. In this machine an accurately divided plate with notched edge is arranged to advance a certain amount (e.g. 10 feet of arc) for each revolution of a tangent screw. The screw is worked by a treadle, and the machine can be adjusted so that a movement of the treadle secures any desired part of a revolution of the screw. In Ramsden's linear machine a divided strip of metal, working in a slot, takes the place of the circular plate.

Ramsden's idea was improved and developed by Troughton and afterwards by Ross and Simms. Machines have also been constructed by Froment and others for dividing small spaces into a large number of intervals. The object to be graduated is slowly and intermittently pushed forward by a screw, while a fine steel or diamond point, working automatically, makes a cut at each cessation of the feeding motion. As many as 225,000 lines marking equal intervals have been cut in the space of 1 inch.

Graffi'ti, the rude designs and inscriptions of popular origin drawn or engraved with a style upon the walls of ancient towns and buildings,

particularly of Rome and Pompeii. Those in Pompeii are in Latin, Greek, and Oscan, showing that the ancient language of Campania was still extant among a portion of the populace. The inscriptions are mostly amatory or humorous, sometimes malicious or obscene. In Rome graffiti occur frequently in the catacombs, some of them belonging to the fourth century having been discovered in 1915. Many of these are by Christians, some by Pagans in ridicule of Christianity.

Grafting, in horticulture, a method of artificial vegetative propagation, in which a twig bearing one or more buds, the scion, is inserted



Cleft-grafting

into a stem (or root) of a rooted plant, the stock. If the operation is successful, union between scion and stock takes place after a time, owing to the growing together of the cambial layers of the two. There are many varieties of grafting, differing in the shape of the surfaces which are brought into mutual contact, or as regards the part of the stock in which the scion is inserted. A common method, termed cleft-grafting, is illustrated in the figure. The objects of grafting are various, such as the perpetuation of a variety which does not set seed, the production of dwarf trees, the encouragement of early fruiting, &c. Budding and inarching (q.v.) are special forms of grafting.—Cf. L. H. Bailey, *The Nursery Book*.

Grafton, Augustus Henry, third Duke of, born 1735, died in 1811. He was Secretary of State under Rockingham, First Lord of Treasury under the elder Pitt, and Premier during the illness of the latter. He subsequently held the Privy Seal under Lord North, and again under

Rockingham, but ultimately gave up politics. He is chiefly remembered as the subject of some of the most scathing of the letters of Junius.

Grafton, a town in New South Wales, on both sides of the River Clarence, here navigable, about 45 miles from the sea. It is a well-built place in a rich agricultural district, containing sugar-mills, and carries on a good trade with Sydney and other places; the see of an Anglican and a Roman Catholic bishop. Pop. 4680.

Graham, John, Viscount Dundee, commonly known as Claverhouse, eldest son of Sir William Graham of Claverhouse, was born about 1650, and educated at St. Andrews. He went abroad and entered the service of France and afterwards of Holland, but, failing to obtain the command of a Scottish regiment in the Dutch service, he returned to Scotland in 1677, where he was appointed captain of a troop of horse raised to enforce compliance with the establishment of Episcopacy. He distinguished himself by an unscrupulous zeal in this service, especially after the murder of Archbishop Sharpe in May, 1679. The Covenanters were driven to resistance, and a body of them defeated Claverhouse at Drumclog on 1st June. On the 22nd, however, the Duke of Monmouth defeated the insurgents at Bothwell Brig, and Claverhouse was sent into the west with absolute power. In 1682 he was appointed sheriff of Wigtownshire, and, assisted by his brother David, continued his persecutions. He was made a Privy Councillor, and received the estate of Dudhope, with other honours from the king, and although on the accession of James his name was withdrawn from the Privy Council it was soon restored. In 1686 he was made brigadier-general, and afterwards major-general; and in 1688, after William had landed, he received from James in London the titles of Lord Graham of Claverhouse and Viscount Dundee. When the king fled he returned to Edinburgh, but finding the Covenanters in possession he retired to the north, followed by General Mackay. After making an attempt on Dundee, Claverhouse finally encountered and defeated Mackay in the Pass of Killiecrankie (17th July, 1689), but was killed in the battle.

Graham, Thomas, Master of the Mint, an eminent chemist, was born at Glasgow in 1805, died in 1869. Educated at Glasgow University, he commenced teaching private mathematical classes in Glasgow in 1827, and in 1829 succeeded to the lectureship of chemistry in the Mechanics' Institution. In 1830 he was appointed professor of chemistry in the Andersonian University. In 1831 he established the law that gases diffuse at a rate inversely as the square root of their specific gravities. He afterwards made a series

of investigations into the constitution of arseniates, phosphates, and phosphuretted hydrogen, and into the function of water in different salts. In 1837 he was elected professor of chemistry in the University of London, and soon after settling in the metropolis he was appointed assayer to the Mint. In 1841 he was chosen first president of the Chemical Society, which he had assisted in founding; and in 1846 he helped to establish the Cavendish Society, over which he presided. In 1840 and in 1854 he read the Bakerian lecture, the subject of both being the diffusion of liquids, which he further treated before the Royal Society in 1861. He distinguished the crystalloids and colloids in liquid solutions, and gave to their separation the name of *dialysis*. In a subsequent paper (*Philosophical Transactions*, 1866) he applied these discoveries to gases, under the name of *atmolysis*. The passage of gases through heated metal plates and the occlusion of gases were also ably investigated by him.

Grahame (grām or grā'am), James, Scottish poet, born in Glasgow in 1765, died there in 1811. He studied law in Edinburgh, and in 1791 became a Writer to the Signet. In 1795 he was admitted to the Faculty of Advocates, of which he continued a member until 1809, when he took orders as a clergyman of the Church of England. Previous to this all his literary productions had been published. While at the university he printed and circulated a collection of poetical pieces. These appeared in an amended form in 1797. In 1801 he published a dramatic poem entitled *Mary, Queen of Scotland*, and in 1802 appeared, anonymously, *The Sabbath*. *The Birds of Scotland* and *British Georgics* are among his other publications.

Grahame-White, Claude, British aviator and builder of aeroplanes, born 21st Aug., 1879. Educated at Bedford Grammar School, he engaged in the motor-engineering business, and in 1909 began to be interested in aeronautics, organizing an aviation school at Pau. The first Englishman to be granted an aviator's certificate, he won the International Gordon-Bennet aeroplane race in America with a Gnome-Bleriot in 1910. The Grahame-White Aviation Company, which he formed, acquired the aerodrome at Hendon, where he started an aviation school. His works include: *The Story of the Aeroplane* (1911); *The Aeroplane, Past, Present, and Future* (1911); *Heroes of the Air: a Book for Boys* (1912); and *The First Airways* (1918).

Graham Island, or *Ferdinandea*, a volcanic island which in July, 1831, rose up in the Mediterranean, about 30 miles south-west of Sciacca, in Sicily. It attained a height of 200 feet, with a circuit of 3 miles, but disappeared in August. It reappeared for a short time in 1863. Jules

Verne's story *Captain Antifer* hinges upon the appearance and disappearance of this island.

Graham Land, a tract of land in the Antarctic Ocean; discovered in 1832 by Biscoe, who took possession of it for Great Britain. It stretches between lat. 63° and 68° s., and lon. 61° and 68° w. There is a meteorological station on the west coast.

Grahamstown, a town of Cape Province, the metropolis of the Eastern Provinces, on the slopes of the Zuurberg. It is a well-built thriving place, with a town hall, an Anglican and a Roman Catholic cathedral, Rhodes University College (founded in 1904), schools, botanic garden, &c. Pop. 15,000 (including 10,000 whites).

Grail (variously spelt *Greal*, *Graal*, *Grazal*, *Grasal*, &c.), the legendary holy vessel, supposed to have been of emerald, from which Christ dispensed the wine at the Last Supper. It was said to have been brought to England by Joseph of Arimathea, but to have been taken back to heaven until the appearance of heroes worthy to be its guardians. Titarel, a descendant of the Asiatic prince Perillus, whose descendants had allied themselves with the family of a Breton sovereign, was chosen as its keeper. He erected for it a temple on the model of that at Jerusalem, and organized a band of guardians. It was visible only to the baptized and pure of heart. With this legend that of King Arthur became connected. Three of his knights, Galahad, Percival, and Bors, had sight of it, and on the death of Percival, its last guardian, it was again taken to heaven. Popular in the Middle Ages, the romance of the Grail was revived by the poets of the nineteenth century (cf. Tennyson's *Idylls of the King*).—BIBLIOGRAPHY: A. Nutt, *Studies on the Legend of the Holy Grail*; E. Rhys, *Studies in the Arthurian Legend*; J. L. Weston, *Legend of Sir Percival*.

Grain includes all those kinds of grass which are cultivated on account of their seeds for the production of meal or flour. All kinds of grain contain the following in varying quantities: water, albuminous substances (gluten, &c.), carbohydrates (starch), fat, and mineral compounds. In the husk are to be found small quantities of the complex substances known as vitamins, essential for the proper nutrition of the body.

Graining (*Leuciscus lancastriensis*), a fish of the dace kind, found chiefly in the Mersey and its tributaries, and in some of the Swiss lakes. The nose is more rounded than that of the dace, the eye larger, and the dorsal fin commences half-way between the point of the nose and the end of the fleshy portion of the tail. The most recent authorities, however, do not recognize it as a distinct species. It seldom weighs more

than half a pound, in habit and food it resembles the trout.

Grain-moth, a minute moth of which two species are known, *Tinea granella* and *Bupalis sitotroga cercalella*, whose larvæ or grubs devour grain in granaries. The moths have narrow, fringed wings, of a satiny lustre.

Grains of Paradise, Guinea grains or Meleguetta pepper, the pungent somewhat aromatic seeds of *Amomum Meleguetta*, nat. ord. Zingiberaceæ, a plant of tropical Western Africa. They are chiefly used in cattle medicines and to give a fiery pungency to cordials. The 'Grain Coast' of Africa takes its name from the production of these seeds in that region.

Grak'le, or **Grackle**, a name applied to the Indian hill-starlings. One of these is the myna bird (*Eulabes religiosa*), which can be taught amusing tricks and can imitate the human voice. It is of a deep velvet-black, with a white spot on the wing, yellow bill and feet, and two yellow wattles on the back of the head. A number of other birds have also been called grakles, such as the purple grackle, or crow-blackbird of America. See *Crow-blackbird*.

Grallato'res, the name, now obsolete, for an artificial assemblage of wading and other birds, such as herons, flamingoes, rails, and cranes. It was devised by Illiger in 1811 as an improvement on Linnæus's ord. Grallæ, which also included bustards and ostriches.

Grammar, that branch of linguistic science which deals with and investigates the system of rules, principles, and facts which must be known in order to speak and write any language correctly. *Comparative grammar* treats of the laws, customs, and forms which are shown by comparison to be common to various languages; *general* or *universal grammar*, of those laws which, by logical deduction, are demonstrated to be common to all. *Historical grammar* deals with the historical development of a given language, from the earliest traces of this language down to the present time. The divisions of grammar vary with the class and also with the method of treatment. In common English grammars the division is generally fourfold: *orthography*, which treats of the proper spelling of words, and includes orthoepy, treating of the proper pronunciation; *etymology*, which treats of their derivations and inflections; *syntax*, of the laws and forms of construction common to compositions in prose and verse; *prosody*, of the laws peculiar to verse. Although the systematization of grammar had begun in some sort in Plato's time, it was chiefly to the Alexandrian writers that it owed its development. The first Greek grammar for Roman students was that of Dionysius Thrax, in use about 80 B.C.

Comparative grammar can only be said to have existed from the beginning of the last century, when the critical study of Sanskrit established the affinities of the languages of the Indo-European group. The names of Bopp, Grimm, Pott, Schleicher, and Müller are especially associated with its development. — **BIBLIOGRAPHY**: H. Sweet, *A New English Grammar, Logical and Historical*; P. Giles, *Manual of Comparative Philology*; T. G. Tucker, *Introduction to the Natural History of Language*.

Gramme. See *Weights and Measures*.

Grammont, a town of Belgium, East Flanders, 22 miles S.S.E. of Ghent, on both sides of the Dender. It was here that the Charter of Grammont was granted in 1068. Chief manufactures: linen, lace, thread, paper, and tobacco-pipes. Pop. 12,619.

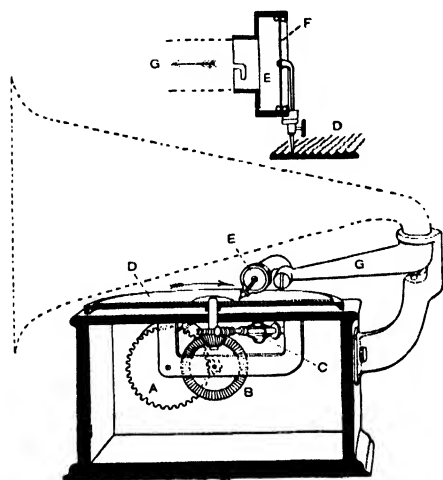
Grammont, Order of (Grandmontains), a monastic order established by Stephen of Thiers in 1076 at Muret, but afterwards (1124) removed to Grandmont. The order became extinct at the Revolution.

Gramont, or **Grammont**, Philibert, Comte de, son of Anthony, Duke of Grammont, born in 1621, died 1707. He served under the Prince of Condé and Turenne, went to England two years after the Restoration, and was highly distinguished by Charles II. A long career of gallantry was terminated by his compulsory marriage to Elizabeth Hamilton. His *Mémoires du Comte de Grammont* were dictated to his brother-in-law, Anthony, Count Hamilton, who followed James II, entered the French service, and died in 1720.

Gramophone, an instrument for recording and reproducing speech and music by purely mechanical means. Thomas A. Edison invented his first talking-machine in 1877, and called it a *phonograph*; and a later inventor introduced the word Gramophone, which was probably suggested by the word *phonogram*. Edison's phonograph may be considered as a direct descendant of the *phonautograph*, which had been invented in 1856 by Leon Scott. In this instrument there was a horn with a stretched membrane closing the narrower end, and to the outside of this membrane there was attached a bristle which acted as a stylus. The free end of this stylus rested on a lamp-blackened paper which was wrapped around a cylinder capable of rotation by means of a crank-handle on the end of a long spindle, on part of which there was a screw-thread fitting into a similarly screwed bearing. Therefore, when the cylinder was rotated, it travelled along also in a horizontal direction, causing the stylus to trace a continuous spiral around the cylinder from the one end to the other. When words were spoken, the stylus traced the vibrations of the diaphragm upon the

blackened paper; there was no suggestion of reproducing the sound.

Between this date (1856) and Edison's phonograph (1877) there had been invented the electric telephone by Graham Bell, so that it was already known that a vibrating disc could reproduce speech. Edison's phonograph combined the ideas of the recording diaphragm of the phonautograph and the reproducing diaphragm of the telephone. In the original instrument (1877) there was a brass cylinder having a deep spiral groove around it, and this cylinder moved exactly as in the phonautograph. As in Scott's machine, the horn with its diaphragm was fixed



Section of a Gramophone

permanently. Attached to the centre of the vibrating diaphragm there was a steel point in contact with a sheet of tin-foil which was wrapped around the brass cylinder. When words were spoken into the mouthpiece, the diaphragm vibrated in sympathy with the air-waves produced by the voice, and the steel point made a succession of minute indentations on the tin-foil. When this record was passed again under the steel point by the rotation of the cylinder, the diaphragm vibrated again exactly as it had done when under the influence of the voice. The air-waves thus generated impinged upon the ear, and caused the same sensation as would have been produced by the speaker's voice when acting directly. In the early phonograph the tin-foil gave a very imperfect imitation of the human voice, and it made little advance for ten years, as Edison was engaged upon the problems of electric lighting, but in 1888 he brought out an improved phonograph. Others had introduced a wax cylinder, and Edison

adopted this in place of his tin-foil record; this was a very great improvement. As early as 1888 Berliner invented a phonograph with flat disc records in place of cylindrical ones, and he christened this machine a *gramophone*, but it should be noted that Edison had made records on flat discs before this date. In Berliner's early gramophone the record was made on a viscous-coated zinc plate. The stylus laid bare the zinc, which was then etched with acid, and from this a copper matrix was made by an electroplating process. This matrix served to stamp out any number of records on a shellac-compound disc, made plastic when heated. Then followed a wax disc in place of a zinc one, and from this a copper matrix was made.

The principle of the modern gramophone is shown in the accompanying diagram. The driving energy is got from a large mainspring contained in the cylinder A, and the power is transmitted to the large bevel wheel B by means of a ratchet wheel and pinion. A bevel pinion fits into B, the pinion being carried on the lower end of a short upright shaft, to the top of which is fastened the turn-table on which the record D is placed. The rate of revolution is kept constant by means of the governor C, which consists of three small weights, each fixed to a flat spring, and all three connected at one end to a stationary collar, while the other ends are fixed to a loose collar, which is capable of sliding on the spindle. When the speed increases beyond the desired limit, the weights tend to fly outward under the influence of centrifugal force, and in moving outwards they pull the loose collar along the spindle and apply a brake, thus retarding the motor until it reaches the speed for which the governor is set. The power is transmitted to the governor spindle by means of a worm and worm-wheel on the end of the spindle running through C. The sound-box E contains the diaphragm, which may be a disc of mica, and to this is attached the stylus, which moves with the vibrations of the diaphragm and cuts the record on the disc of wax. In reproducing the sound the stylus is moved to and fro by the irregular grooves of the record, thus causing the diaphragm to vibrate just as it did under the direct influence of the voice or musical instrument. A large horn, acting as a megaphone, is attached to the tone-arm G, which is a metal tube connecting the sound-box to the horn. The smaller illustration is an enlargement of the sound-box E, showing the position of the mica diaphragm F, with its stylus, on the lower end of which is a socket and thumb-screw for holding the needle point in place. The grooves of the record D have been enlarged to show how the needle moves in the groove. The arrow indicates the direction of

the propagation of the air-waves produced by the vibrating diaphragm \mathbf{r} , and leading through the tone-arm \mathbf{g} to the horn.

Grampians, The, a range, or rather series of ranges and elevated masses, stretching across Scotland diagonally s.w. to n.e. for about 150 miles. It commences in Argyshire, and at the boundaries of Perthshire and Aberdeenshire may be said to separate into two distinct branches—one on the north side of the Dee, terminating near Huntly; the other running on the south side of that river, and terminating near Stonehaven. With the exception of Ben Nevis, the Grampians comprise all the highest mountains in Scotland, Ben Cruachan, Ben Lomond, Ben Lawers, Schichallion, Ben Macdhuì (4296 feet), Cairngorm, and Cairntoul. The more remarkable passes are those of Leny, Aberfoyle, Glenshee, and Killiecrankie.

Grampus, a popular name for several marine cetaceous mammals allied to the dolphins, especially *Orca gladiator* of the Atlantic and North Sea, which grows to the length of 30 feet, and is remarkably thick in proportion to its length. The spout-hole is on the top of the neck. The colour of the back is black; the belly is of a snowy whiteness, and on each shoulder is a large white spot. The grampus is carnivorous and remarkably voracious, even attacking the whale. The genus *Grampus* only includes Risso's dolphin (*G. griseus*) from the Mediterranean and Atlantic; and this is allied to the ca'ing whale (*Globicephalus melas*) of the North Atlantic; this attains the length of 20 feet.

Gran (*Esztérgom*), a town in Hungary, at the confluence of the Gran with the Danube, 25 miles north-west of Budapest. It was the residence of the Hungarian monarchs, and their finest city till ruined by the Turks about 1613. It is an archbishop's see and has a fine cathedral. Gran is the Etzelburg of the *Nibelungenlied*. Pop. 17,120.

Granada (grā-nā'dā), a city in the south of Spain, capital of the province of Granada. The streets rise picturesquely above each other, with a number of turrets and gilded cupolas, the whole being crowned by the Alhambra (q.v.), or palace of the ancient Moorish kings. In the background lies the Sierra de Nevada, covered with snow. The streets, however, are narrow and irregular, and the buildings inferior to those of many other towns in Spain. The town is partly built on two adjacent hills, between which the Darro flows, traversing the town and falling into the Genil, which flows outside the walls. The cathedral is an irregular but splendid building, and the archbishop's palace and mansion of the captain-general are also noteworthy; but the special features of the town are the Alhambra, and another Moorish

palace called the *Generalife*, built on an opposite hill. Granada has no manufactures of importance. Its university was founded about 1530, and is attended by some 1000 students. The city was founded by the Moors before 800, and from 1036 to 1234 was included in the Kingdom of Cordova. In 1235 it became the capital of the Moorish kingdom of Granada, and attained almost matchless splendour. In 1491 it remained the last stronghold of the Moors in Spain, but was taken by the Spaniards under Ferdinand and Isabella in 1492, along with the kingdom, having then a population of perhaps 500,000. Its prosperity continued almost without diminution till 1610, when the decree expelling the Moors from all parts of Spain told severely upon it, and it has never recovered. Pop. (1918), 82,820.—The province, which is partly bounded by the Mediterranean, has an area of 4028 sq. miles. Pop. (1919), 545,217.

Granada, formerly a Moorish kingdom in Spain, bordering on the Mediterranean, now represented by the three provinces Granada, Almeria, and Malaga; area, 11,128 sq. miles. The interior is mountainous, being traversed from east to west by several ranges, particularly the Sierra Nevada; but many of its valleys and low grounds are distinguished by beauty and fertility. The olive and vine are extensively cultivated, and fruit is very abundant. The sugar-cane thrives in some parts. After long forming part of the Kingdom of Cordova, Granada became a separate kingdom in 1235. In 1492 it passed into the possession of the Spaniards.

Granadilla, the West Indian name for the fruits of various species of *Passiflora*, a genus of the passion-flower family. Some species have been introduced into Europe, chiefly for their flowers, the chief being the purple-fruited, *P. edulis*; the water-lemon, *P. laurifolia*; the flesh-coloured granadilla, and the *P. quadrangularis*, the most valuable for cultivation in Great Britain.

Granby, John Manners, Marquess of, son of the Duke of Rutland, born 1721, died in 1770. He was educated at Eton and Cambridge; raised a foot regiment in 1745; became colonel of the Horse-Guards in 1758 and lieutenant-general in 1759; commanded the British troops in the Seven Years' War (1760-3); and was commander-in-chief of the British army from 1766 to 1770. He was elected to Parliament in 1754, 1761, and 1768. Granby's immense popularity, which was, however, scarcely earned by his merits as a general, was in part attested by the frequent use of his name for inns and public-houses. 'The Marquess of Granby' was the name of the inn at Dorking owned by the second Mrs. Weller (*Pickwick Papers*, chap. 27). Granby was fiercely attacked by Junius.

Gran Chaco, El, a territory of the Argentine Republic, lying mainly between the Vermejo, Paraná, and Salado; area, 52,740 sq. miles. In the west it is intersected by offsets of the Andes, and in the east forms extensive plains and marshes, while in the south are sandy tracts interspersed with salt pools. A large area, however, is covered with primeval forest. It is inhabited by Indian tribes, the Indian population being estimated at from 20,000 to 40,000. Many parts seem well adapted for growing sugar-cane, tobacco, maize, rice, &c., if not for cereals generally. The name also embraces a much more extensive region extending into Bolivia.

Grand Couronné de Nancy, a range of wooded hills in France, department of Meurthe-et-Moselle. It was the scene of fierce fighting during the European War (24th Aug. to 7th Sep., 1914).

Grand Coustumier of Normandy, a collection of ancient laws or customs of the Duchy of Normandy, in use in England during the reigns of the early Norman sovereigns, and which still form the basis of the laws of the Channel Isles, which formerly belonged to that duchy. It is supposed to have been compiled subsequently to the reign of Richard I.

Grand-Duke, before the Revolution of 1918 the title of the sovereign of several of the states of Germany, who were considered to be of a rank between duke and king. The title was also applied until 1918 to members of the imperial family of Russia.

Grandee, in Spain a noble of the first rank, which consisted partly of the relatives of the royal House, and partly of such members of the high feudal nobility distinguished for their wealth as had, by the grant of a banner received from the king, the right to enlist soldiers under their own colours. Besides the general prerogatives of the higher nobility, and the priority of claim to the highest offices of State, the grandees possessed the right of covering the head in the presence of the king, with his permission, on all public occasions. The king called each of them 'my cousin' (*mi primo*), while he addressed the other members of the high nobility only as 'my kinsman' or 'my relative' (*mi pariente*). Under Ferdinand and Isabella and Charles V the independent feudal nobility became a dependent order of court nobles, and their privileges were curtailed. Entirely abolished after the accession of Joseph Bonaparte, the privileges of the grandees were partially re-established after the Restoration of 1814.

Grand Jury, a body of jurors numbering not less than twelve nor more than twenty-three, summoned by the sheriff to hear the evidence

for the prosecution in indictable offences, and upon such evidence to find whether there is sufficient cause for sending the prisoner to trial. If the jury find no *prima facie* case, the indictment is 'ignored', and the finding is that there is 'no true bill'; but if otherwise, they bring in 'a true bill', and the prisoner is then committed for trial before a judge and a common or petty jury. (This procedure is not applicable to Scotland.) By virtue of an Act passed in 1917 it was suspended for the period of the European War, and by 1921 it had not been restored. See *Jury*.

Grand Pensionary, formerly an officer of the Dutch Republic, or rather of the Province of Holland. In the great towns of the Dutch Republic the first magistrate was called a pensionary, from the fact of his office being a paid one. The grand pensionary was the Secretary of State of the Province of Holland. He held office for five years, and was eligible for re-election. The office was abolished on the formation of the Kingdom of Holland in 1806.

Grand Rapids, a city, United States, capital of Kent County, Michigan, situated on the rapids of the Grand River, 40 miles from its mouth. It is handsomely built, and has a pleasant and healthy situation. It is connected with the railway system of the United States and Canada, and is an important centre for the distribution of pine and hard-wood lumber. It has large manufactures of furniture, wooden ware, agricultural implements, brushes, and machinery. Pop. (1920), 137,634.

Grand Sergeanty, an ancient tenure of land similar to knight-service, but of superior dignity. Instead of serving the king generally in his wars, the holder by this tenure was bound to do him some specified honorary service, to carry his sword or banner, to be the marshal of his host, his high-steward, butler, champion, or other officer. It was practically abolished with other military tenures by Charles II.

Grange, or **Grange Party**, in the United States, a combination, society, or lodge of farmers for the purpose of promoting the interests of agriculture, more especially for abolishing the restraints and burdens imposed on it by the commercial classes and the railroad and canal companies, and for doing away with middlemen. Granges originated in the great agricultural regions of the Mississippi, and still prevail most generally there. The movement, which lost its influence after 1873, was revived in 1890.

Grangemouth, a seaport and police burgh, Stirlingshire, Scotland, at the entrance of the Forth and Clyde Canal, 3 miles E.N.E. of Falkirk. The town was founded in 1777 in connection with the construction of the canal; it has docks

opened respectively in 1843, 1859, and 1882. It has shipbuilding yards, sawmills, a rope and sail factory, and brickworks. An oil-pipe line from Dalmuir was completed in 1918. Pop. 9699.

Granite, a coarsely crystalline unstratified rock, composed generally of the minerals quartz, potassium-felspar, and mica, mingled without regular arrangement of the crystals. Granite is an igneous rock which has consolidated under pressure deep down in the earth. It is one of the most abundant of the igneous rocks seen at or near the surface, and was formerly considered as the foundation rock of the globe, or that upon which all sedimentary rocks repose; but it is now known to belong to various ages from the Pre-Cambrian to the Cainozoic, the Alps of Europe and the hills of Skye containing granite of the latter age. It forms some of the most lofty mountain chains, and many parts of the principal ranges of Scandinavia, the Alps, the Pyrenees, and the Carpathian Mountains are of this rock. Granite supplies the most durable materials for building, as many of the ancient Egyptian monuments testify. It varies much in hardness as well as in colour, in accordance with the nature and proportion of its constituent parts, so that there is much room for care and taste in its selection. The Aberdeen bluish-grey granite is celebrated for its great durability, and also for its beauty. The Peterhead red granite, the hue of which is due to its felspar being flesh-coloured, is highly esteemed for polished work, as columns, pillars, graveyard monuments, &c. In some granites, mica is replaced by hornblende; when both mica and hornblende are present, it is called *syenitic granite*. The name of *graphic granite*, or *pegmatite*, is given to a variety composed mainly of felspar and quartz, so arranged as to produce an interlocked structure. The quartz and potassium-felspar have here crystallized simultaneously, and the name graphic granite arises from the resemblance of the irregularly developed quartz, as seen on a broken surface, to Hebrew characters. The term pegmatite has now been extended to any coarse granite found in veins. Granite contains many accessory minerals, such as beryl, garnet, and tourmaline. It is not rich in metallic ores.

Gran'itite, a granite containing both dark and light mica in addition to the quartz and felspar.

Granophyre, a fine-grained granitic rock in which the groundwork has the structure of graphic granite (see *Granite*) on a small scale. The Cainozoic granite of the Inner Hebrides and the Mourne Mountains is now commonly styled granophyre.

Gran Sasso D'Italia, or Monte Corno, a mountain of Naples, the culminating peak of the Appenines; height, 9585 feet.

Grant, in law, a gift in writing of such a thing as cannot be passed or conveyed by word only; thus, a grant is the regular method by the common law of transferring the property of incorporeal hereditaments, or such things whereof no actual delivery of possession can be had.

Grant, Sir Alexander, Bart., born in 1826, died in 1884. He was educated at Harrow and Oxford, where he was public examiner in 1856. In 1858 he was appointed inspector of schools in the Madras Presidency; became professor of history and political economy in Elphinstone College, Madras, in 1860, and its principal in 1862; vice-chancellor of Bombay University in 1863; director of public instruction in Bombay Presidency in 1865; and vice-chancellor and principal of Edinburgh University in 1868. He is best known by his annotated edition of Aristotle's *Ethics* (first published 1857), and his *Story of the University of Edinburgh during its First Three Hundred Years* (1884), published in connection with the University Tercentenary.

Grant, Sir Francis, Scottish painter, born 1803, died 1878. The son of a landed proprietor, he was self-taught as a painter, but became noted for sporting scenes and portraits, afterwards painting many persons of note, including Queen Victoria, the Prince Consort, Lord John Russell, Disraeli (Beaconsfield), Lord Clyde, Palmerston, Macaulay, Landseer, Sir Hope Grant, J. G. Lockhart, &c. He became A.R.A. in 1842, R.A. in 1851, and president of the Academy in 1866, in which year he was knighted.

Grant, George Munro, Canadian author and educationalist, born in Nova Scotia in 1835, died in 1902. He was educated at Pictou Academy, and at West River Seminary of the Presbyterian Church of Nova Scotia, gaining there a bursary which entitled him to continue his studies at Glasgow University. Here he studied with distinction both in arts and theology, and took the degree of M.A. Returning to Canada, he was for some time a missionary, then pastor of St. Matthew's Church, Halifax. In 1877 he was appointed principal of Queen's University, Kingston, Ontario, a position which he filled with great ability. His works include: *Religions of the World in Relation to Christianity*; *Reformers of the Nineteenth Century*; and *Ocean to Ocean*, being the account of a tour across the Dominion. He also edited *Picturesque Canada*, and contributed to various periodicals.

Grant, James, novelist, born at Edinburgh 1822, died in 1887. He lived in America from 1832 to 1839, in which year he returned to England, and was gazetted ensign in the 62nd Foot. He resigned his commission in 1843; began to contribute to periodical literature, and in 1846 published his first book, *The Romance of War*. A large number of works followed,

most of them bearing marks of his military training, or based on historical events: *Adventures of an Aide-de-Camp* (1843), *Bothwell* (1851), *Jane Seton* (1853), *Philip Rollo* (1854), *Frank Hilton* (1855), *Yellow Frigate* (1855), *Harry Ogilvie* (1856), *Lucy Arden* (1859), *Mary of Lorraine* (1860), *Dick Rodney* (1861), *King's Own Borderers* (1865), *White Cockade* (1867), *British Battles on Land and Sea* (1873), and *Old and New Edinburgh* (1880-3).

Grant, James Augustus, Scottish soldier and traveller, born 1827, died 1892; is chiefly noted as having accompanied Captain Speke in his search for the sources of the Nile (1860-3). The travellers explored the Victoria Nyanza, and discovered the river issuing from the lake, an expedition described in his work *A Walk Across Africa*. He also wrote *The Botany of the Grant and Speke Expeditions* (*Transactions of Linnean Society*, vol. xxix).

Grant, Ulysses Simpson, general and eighteenth President of the United States, born in 1822 at Point Pleasant, in Clermont County, Ohio, died in 1885. His real name was Hiram Ulysses Grant, the name afterwards used by him having arisen out of an error in the registration of his cadetship. After having studied in the military academy at West Point he served during the Mexican War, taking part in every battle except Buena Vista, and being brevetted captain for gallantry. In 1854 he resigned his commission and engaged first in farming near St. Louis, and then in the leather trade with his father at Galena, Illinois. On the declaration of war in 1861 he was chosen captain of a company of volunteers, and was rapidly promoted to a brigadier-generalship of volunteers. He seized Paducah, commanding the Tennessee and Ohio navigation; checked the departure of reinforcements from Belmont, captured Fort Henry and Fort Donelson, and won the two days' battle of Shiloh. He then gained a new victory at Juka, and after repulsing the Confederates before Corinth commenced operations against Vicksburg. After a siege of some months, in the course of which he took the town of Jackson and scattered an army under Johnston, the town surrendered. For this Grant was made major-general in the regular army, and placed in command of the Mississippi division. The battles of Chickamauga and Chattanooga, which followed, opened the way into Georgia for the Federal troops. In Feb., 1864, he was appointed lieutenant-general, and assumed command of the armies of the United States. In a succession of hotly-contested battles at the Wilderness, Spottsylvania, North Anna, and Cold Harbour, he steadily advanced on Petersburg and Richmond. These speedily fell, and Lee, defeated at Five Forks and completely surrounded, sur-

rendered to Grant on 9th of April, 1865. Grant returned to Washington, and in 1866 was made general of the armies of the United States. After exercising an important influence during the presidency of Johnson, Lincoln's successor, he was himself elected President in 1868. His administration allayed the soreness which still survived from the great struggle between the states, and was also noteworthy for the reduction of the national debt and the settlement of the *Alabama* dispute with England. He was re-elected in 1872. On his retirement he spent some time in travel. Afterwards he became involved in a bubble company which exploited his name and left him heavily in debt. He manfully endeavoured to repair his fortune by writing and publishing his *Memoirs*, and in this he was successful, though suffering greatly from the cancerous disease of which he died.—Cf. H. Garland, *Ulysses S. Grant: his Life and Character*.

Grantham (grant'am), a municipal and until 1918 a parliamentary borough of England, in Lincolnshire, 22½ miles s.s.w. of Lincoln. It is well built, principally of brick, and has a fine Gothic church built in the thirteenth century, with a graceful tower and spire 273 feet high. The town hall has a handsome clock-tower. Among the notable buildings are the thirteenth-century Angel Inn, where Richard III signed Buckingham's death warrant, and the grammar school (founded in 1528), where Sir Isaac Newton was educated. The George Inn, rebuilt in 1780, is described in *Nicholas Nickleby*. The industries are mostly connected with agriculture. Pop. 18,902.

Grantown-on-Spey, a village of Scotland, Elginshire; a favourite summer-resort. Pop. 1622.

Granulation, the subdivision of a metal into small pieces or thin films, effected either by pouring the metal in a fine stream or through a sieve into water. It is employed in chemistry to increase the surface, so as to render the metal more susceptible to the action of reagents, and in metallurgy for the subdivision of a tough metal like copper. Furnace slags are also frequently granulated by causing the stream of molten slag to be met by a stream of water under pressure.

Granulation, in surgery, the formation of little grain-like fleshy bodies on the surfaces of ulcers and suppurating wounds, serving both for filling up the cavities and bringing nearer together and uniting their sides. The colour of healthy granulations is a deep florid red. When livid they are unhealthy, and have only a languid circulation.

Granvella, or **Granvelle**, Antoine Perrenot, Cardinal de, Minister of State to Charles V and

Philip II of Spain, was born in 1517 near Besançon, died at Madrid in 1586. He studied at Padua and at Louvain, in his twenty-third year was appointed Bishop of Arras, and was present at the Diets at Worms and Ratisbon. In 1545 he was sent to the Council of Trent, and on the death of his father in 1550 was appointed by Charles V to succeed him in the office of Chancellor. In 1552 he negotiated the Treaty of Passau, and in 1553 arranged the marriage of Don Philip with Mary, Queen of England. Under Philip II he remained chief minister, and in 1559 negotiated the Peace of Câteau-Cambrésis. Philip immediately after quitted the Netherlands, leaving Margaret of Parma as Governor, and Granvella as her minister. In 1560 he became Archbishop of Mechlin, and in 1561 was made a cardinal; but in 1564 he was obliged to yield to the growing discontent aroused by his tyranny in the Netherlands, resign his post, and retire to Besançon. In 1570 Philip sent him to Rome to conclude an alliance with the Pope and the Venetians against the Turks, and afterwards to Naples as Viceroy. In 1575 he was recalled to Spain, and placed at the head of the Government with the title of President of the Supreme Council of Italy and Castile. In 1584 he was created Archbishop of Besançon, and died at Madrid. He preserved all letters and dispatches addressed to him, nine volumes of which, published 1851-62, are of value in illustrating the history of the sixteenth century. Another edition of his correspondence appeared at Brussels between 1878 and 1896 (12 vols.).

Granville, Granville George Leveson-Gower, second Earl, English statesman, was born in London in 1815, died in 1891. Educated at Eton and Christ Church, Oxford, he entered Parliament in 1836 for Morpeth, afterwards for Lichfield, both in the Liberal interest. In 1840 he became Under-Secretary for Foreign Affairs, in 1846 succeeded to the peerage, in 1848 was appointed Vice-President of the Board of Trade, and in 1851 succeeded Palmerston as Foreign Secretary. In 1855 he became Chancellor of the Duchy of Lancaster, President of the Council, and ministerial leader of the House of Lords (1855-8), and in 1856 represented the British Crown at the coronation of the Tsar Alexander. From 1859 to 1866 he was again President of the Council. In 1868 he was Colonial Secretary under Gladstone, and on the death of Clarendon in 1870 succeeded to the Secretaryship for Foreign Affairs, which he held until 1874. During this period he negotiated the Treaty of 1870, guaranteeing the independence of Belgium, and 'protested' against the Russian repudiation of the Black Sea clause of the Treaty of Paris. On the return of Gladstone to office in 1880 Lord Granville again became Foreign Secretary,

until Lord Salisbury came into power in 1885. The patched-up peace with the Boers, the protest against the French occupation of Tunis, the revolt of Arabi Pasha in Egypt, the appearance of the Mahdi, the occupation of Egypt, the Gordon mission, and Wolseley expedition belong to this period. In the short Gladstone ministry of 1886 he was Colonial Secretary.—Cf. Lord Fitzmaurice, *Life of Granville G. Leveson-Gower, Lord Granville*.

Granville (gràn-vêl), a fortified seaport, France, department of Manche, at the mouth of the Boscq, in the English Channel. Pop. 11,347.

Grape-fruit, a fruit akin to the orange, but somewhat larger, grown in Jamaica and other West Indian islands, in Florida, and elsewhere, having a bitter-sweet flavour, and a juice considered wholesome and refreshing. Closely allied varieties are the *pomelo* and *forbidden-fruit*.

Grape-hyacinth, the common name of plants of the lily family and genus *Muscari*, charming early spring-flowering bulbs, with flowers mostly of different shades of blue, on scapes 4 to 8 inches high; easily grown in borders and pots.

Grape-shot, a kind of shot generally consisting of three tiers of cast-iron balls arranged, three in a tier, between four parallel iron discs connected together by a central wrought-iron pin. Case-shot superseded grape-shot; both have long been superseded by shrapnel.

Graph, a line or curve which represents the relation between two variable quantities. We get the same kind of information from a graph as from a table of statistics or from a mathematical formula, and we get it usually at a smaller cost of time and mental exertion. As an example, take the following numbers giving the height of the barometer in inches at 9 a.m. on seven consecutive days:

Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Sun.
28·2	28·6	29·15	29·55	30·15	29·95	28·95

On a sheet of squared paper, take ten of the smallest divisions, measured vertically, to represent 24 hours; and ten of the same divisions, measured horizontally, to represent 1 inch of pressure. Then, to indicate the reading 28·2 on Monday at 9 a.m., we mark, or *plot*, the point which lies on the horizontal line corresponding to Monday at 9 a.m., and also on the vertical line corresponding to 28·2 inches. Similarly, we plot the other points marked with a small circle in fig. 1. The seven points marked on the squared paper exactly represent the seven facts

recorded in the table. So long as we know nothing beyond these seven data, we cannot proceed further with any confidence in the construction of a graph. Between Monday at 9 a.m. and Tuesday at 9 a.m., e.g., the barometer may either have risen steadily, or have gone up and down several times. Sometimes, in a case like this, consecutive points are joined by straight lines, the understanding then being that no

read off the rate of rise or fall at any time, as well as the maximum height and the time when it occurred.

In fig. 2 two axes of co-ordinates (q.v.), OX and OY, are shown with the scales marked. In this figure the same length is taken for the unit of x as for the unit of y , but it is often convenient to have different lengths for the two units. The oblique straight line shown is the graph of the

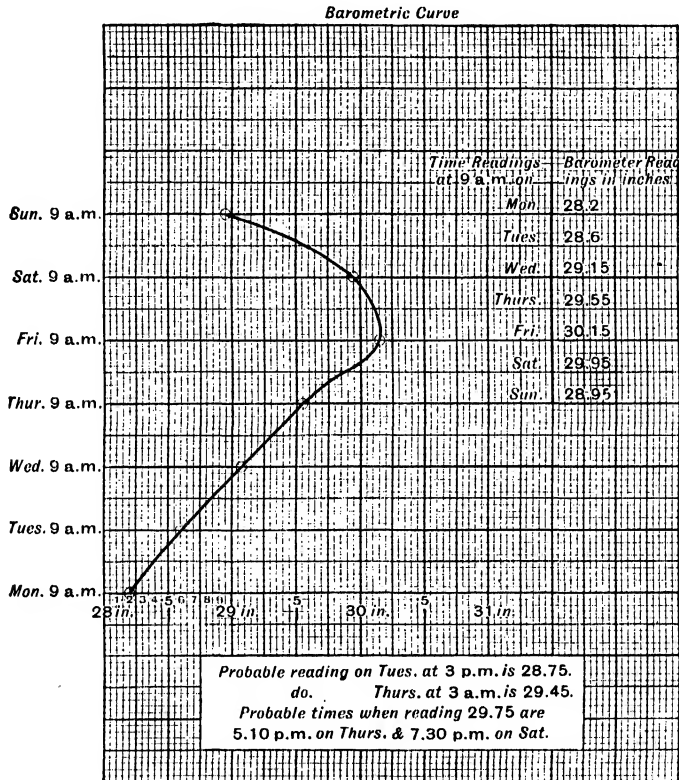


Fig. 1

inference is to be drawn from any part of the graph except the plotted points. If, however, we assume that the variation of pressure proceeded gradually and regularly, then we can draw a smooth curve through the plotted points, as in fig. 1, and take this curve to represent the pressure at any time between the first and the final readings. If the curve is traced continuously by some automatic recording apparatus, all uncertainty disappears, and the graph gives the height correctly for any value of the time. We learn from the curve the time for any given reading, and also the reading for any given time; examples are given on the figure. We can also

equation $2x + 5y = 10$, or of the function $y = \frac{1}{5}(10 - 2x)$. The graph of every function of the first degree is a straight line. Here, for example, the values (2, 1.2) for (x, y) satisfy the equation, and the point $(x = 2, y = 1.2)$, or (2, 1.2), lies on the line; the same happens with (3, .8) and (4, .4). The graph marked (i) represents the function $y = \log x$, the base being 10. To draw this graph, a number of logs are found from the tables, those used in the figure being the logs of .1, .3, .5, .7, 1, 1.5, 2.5, 4, 5. The corresponding points, such as (2, .30), (3, .48) are then plotted, and a smooth curve is drawn through them. The log of any intermediate

number can now be read off the graph, and other problems can be solved. Thus, e.g., a value of x satisfying the equation $2x + 5 \log x = 10$ can be found. For this equation is the same as $\log x = \frac{1}{5}(10 - 2x)$, which is evidently true for the value of x at the point where the straight line and the log graph intersect, i.e. for $x = 3.62$. The dotted graph (ii) represents $y = 10^x$, or $y = \text{antilog } x$; this graph can be plotted from the same numbers as before, for $y = 10^x$ implies

Bohemia. Graphite may be heated to any extent in close vessels without change; it is exceedingly unchangeable in the air; it has an iron-grey colour, metallic lustre, and granular texture, and is soft and unctuous to the touch. It is used chiefly in the manufacture of pencils, crucibles, and portable furnaces, in burnishing iron to protect it from rust, for giving a smooth surface to casting moulds, for coating wax or other impressions of objects designed to be

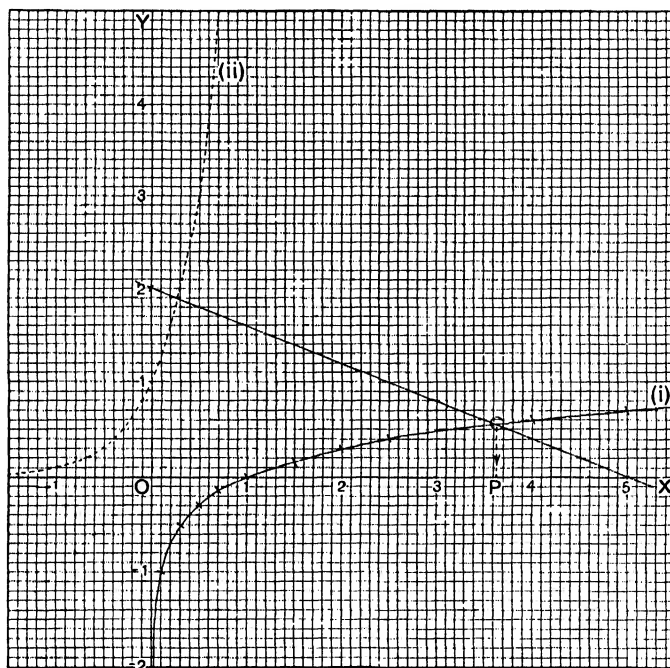


Fig. 2

$x = \log y$. It often happens that an equation can be solved easily and with sufficient accuracy by means of a graph, when other methods would be tedious if not impracticable. Graphical methods for the representation of facts and the solution of problems are now much used in all departments of applied mathematics. See *Indicator*; *Vectors*; *Recording Apparatus*; *Statics*; *Statics, Graphic*; *Thermodynamics*. — BIBLIOGRAPHY: G. A. Gibson, *Treatise on Graphs*; E. H. Chapman, *Elementary Algebra*.

Graph'ite, one of the forms under which carbon occurs in nature, also known under the names of *Plumbago*, *Black-lead*, and *Wad*. It occurs not infrequently as a mineral production, and is found at Borrowdale in Cumberland, and in large quantities in Canada, Ceylon, and

electrotyped, and for counteracting friction between the rubbing surfaces of wood or metal in machinery. Artificial graphite is produced by the treatment of anthracite in the electric furnace.

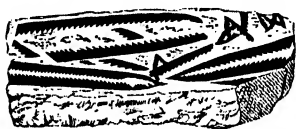
Graphol'ogy, the judging of a person's character by means of his handwriting, a pursuit that has attained some vogue. The tendency to regard a certain style of writing as indicative of certain mental and moral characteristics appears to be natural, and is certainly not of modern origin; but the term graphology is modern, being attributed to the Abbé Michot in 1808, who also expounded a corresponding system, though other French writers, besides those of other nationalities, are said to have placed it on a more secure basis. We are told

that as gestures, movements of the features and the hands, and the sound of the voice help to reveal a person's character, so also handwriting can give us similar help, writing being the result of a series of small gestures, and the hands being influenced by the thoughts and feelings of the writer. But there is a good deal of scepticism regarding graphology.

Grapnel, a sort of small anchor, fitted with four or five flukes or claws, and commonly used to fasten boats or other small vessels. The name was also given to the grappling-iron formerly used in naval engagements to hold one ship to another.

Grapple-plant, the Cape name of the *Harpagophytum procumbens*, a South African procumbent plant of the nat. ord. Pedaliaceæ. The fruits have many hooked thorns, and cling to the mouths of grazing cattle, causing considerable pain.

Graptolite, a member of a group of fossil hydrozoa, agreeing with the living sertularians



Block of Stone containing Graptolites

in having a horny polypary, and in having the separate zooids protected by little horny cups, all springing from a common flesh or cœnosarc, but differing in that they were not fixed to any solid object, but were permanently free. Graptolites usually present themselves as silvery impressions on hard black shales of the Ordovician and Silurian systems. The Ordovician graptolites have two or even four rows of cells on the same axis, or else two or more axes diverging from a common origin; those of Silurian times have typically one row of cells on a single axis. The axes are sometimes found united to a floating disc. The genera and species of graptolites have proved very useful as indicating successive zones in the early Palæozoic systems.

Graslitz, or **Kraslice**, a town of Bohemia, Czecho-Slovakia, on the Zwoda, 89 miles w.n.w. of Prague. Pop. 39,216.

Grasmere, a beautiful lake, England, county of Westmorland, of oval form, about 1 mile long by $\frac{1}{2}$ mile broad. The village of Grasmere is at the head of the lake. Wordsworth and Hartley Coleridge are buried in Grasmere churchyard.

Grass-cloth, the name of certain beautiful light fabrics made in the East from the fibre of *Bahmeria nivea*, or China grass, *Bromelia*

pinguin, &c. None of the plants yielding the fibre are grasses.

Grasse (gràs), a town, France, department of Alpes Maritimes, 23 miles E.N.E. of Draguignan. It has extensive manufactures of perfumery. Grasse is a favourable winter-resort for invalids. Pop. 19,700.

Grasses, a name equivalent to the botanical order Graminaceæ a very extensive and important order of monocotyledons, comprising about 250 genera and 4500 species, including many of the most valuable pasture plants, all those which yield corn, the sugar-cane, the tall and graceful bamboo, &c. The nutritious herbage and farinaceous seed furnished by many of them render them of incalculable importance, while the stems and leaves are useful for various textile and other purposes. The roots are fibrous; the stem or culm is usually cylindrical and jointed, varying in length from a few inches to 80 or 90 feet, as in the bamboo (in maize, sugar-cane, &c., the stem is solid), and coated with silica; leaves, one to each node or joint, with a sheathing petiole; spikelets terminal, panicle, racemose, or spiked; flowers hermaphrodite or polygamous, destitute of true calyx or corolla, surrounded

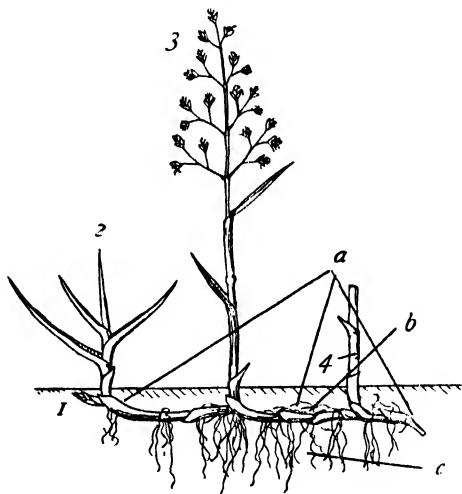
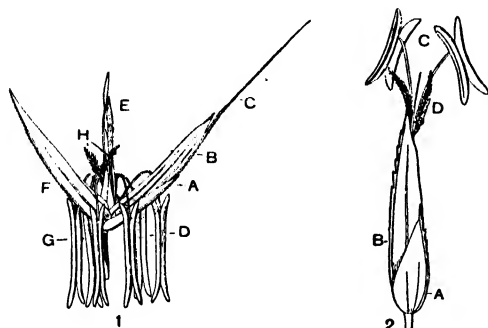


Diagram showing mode of growth of an Underground Creeping Grass

1, Shoot in bud form (current year). 2, Barren shoot (was in bud form last year). 3, Fertile shoot (was a barren shoot two years ago). 4, Old stump (was a fertile shoot three years ago). a, Underground stem for storage and propagation. b, Its scale leaves. c, Its root fibres.

by a double set of bracts, the outer or *glumes* subtending the whole spikelet, the inner or *paleæ* enclosing the individual flower; stamens hypogynous, three or six; filaments long and flaccid; anthers versatile; ovary solitary, simple,

with two (rarely three) styles, one-celled, with a single ovule; fruit known as a *caryopsis*, the seed-coat and the pericarp being inseparable from each other. The more important divisions



Grasses

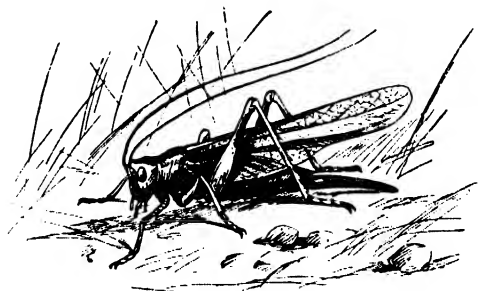
1, Flowering spikelet of tall Oat (magnified). A, Lower glume. B, Lower pale of male flower. C, Its awn. D, Its three stamens. E, Its upper pale. F, Upper glume. G, Three stamens of perfect flower. H, Two feathery stigmas of perfect flower. 2, Flowering spikelet of Sweet Vernal (magnified). A, Small lower glume. B, Large upper glume. C, The two stamens protruded from the apex. D, The two brush stigmas protruded from the apex.

of the natural order of grasses are: the Paniceæ (millet, fundi, Guinea grass); the Andropogonæ (sugar-cane, dhurra, lemon-grass); the Maydeæ (maize, Job's tears); the Phalarideæ (canary-grass, vernal grass); the Oryzæ (rice); the Stipeæ (feather-grass, esparto); the Agrostidæ (bent-grass, foxtail grass, Timothy grass); the Avenæ (oats, soft grass); the Festuceæ (fescue, meadow-grass, manna-grass, teff, cock's-foot grass, tussac grass, dog's-tail grass); the Bambuseæ (bamboo); the Hordeæ (wheat, barley, rye, spelt, rye-grass, lyme-grass). In its popular use the term grasses is chiefly applied to the pasture grasses as distinct from the cereals, &c.; but it is also applied to some herbs, which are not in any strict sense grasses at all, e.g. rib-grass, scurvy and whitlow grass. After the culture of herbage and forage plants became an important branch of husbandry, it became customary to call the clovers, trefoils, sainfoin, and other flowering plants grown as fodder, *artificial grasses*, by way of distinction from the grasses proper, which were termed *natural grasses*. Of the pasture grasses, some thrive in meadows, others in marshes, on upland fields, or on bleak hills, and they by no means grow indiscriminately. Indeed the species of grass will often indicate the quality of the soil; thus, *Holcus*, *Dactylis*, and *Bromus* are found on sterile land, *Festuca* and *Alopecurus* on a better soil; *Poa* and *Cynosurus* are only found in the best pasture land. See *Dog's-tail Grass*; *Fescue*; *Foxtail*; *Tussac*; &c.

Grass-finch, or **Grass-quilt**, names given to buntings of the genus *Phonipara* (Euethia), native to the West Indies and Florida.

Grass'hopper, the name of various leaping insects of the ord. Orthoptera, included with locusts in the family Acridiidae. They are characterized by short antennæ, by very long and slender legs, the thighs of the hinder legs being large and adapted for leaping, by large and delicate wings, and by the wing-covers extending far beyond the extremity of the abdomen. Grass-hoppers are distinguished by the power which they possess of leaping to a considerable distance, and by the stridulous or chirping noise the males produce by rubbing the outer surfaces of their wing-cases against file-like ridges on the inner surfaces of their hind-legs. There is an organ of hearing in the basal segment of the abdomen. They are often of a greenish colour. Green grass-hoppers, *par excellence*, belong to a different family (Locustidae), and are more delicate in structure. They include a British species (*Locusta viridissima*) and the North American Katydid (*Microcentrum retinerve*). The antennæ are long and slender; the auditory organs are lodged in the front legs, below the knee; the chirping organs of the male are on the bases of the wing-covers; and the female usually possesses an ovipositor.

Grass of Parnassus, a genus of plants, ord. Saxifragaceæ, and found for the most part in boggy situations in the colder northern countries. The common grass of Parnassus (*Parnassia palustris*) is a beautiful autumnal

Grasshopper (*Locusta viridissima*)

plant with heart-shaped leaves and a single yellowish-white flower.

Grass-oil, **Oil of Geranium**, or **Oil of Spikenard**, a fragrant volatile oil, used chiefly in perfumery, and obtained from Indian grasses of the genus *Andropogon*.

Grass-tree, the popular name of a genus of Australian plants (*Xanthorrhoea*) of the nat. ord. Liliaceæ, having shrubby stems with tufts of long grass-like wiry foliage, from the centre

or which arise the tall flower-stalks, which sometimes reach the height of 15 or 20 feet, and bear dense cylindrical spikes of blossom at their summit. The base of the leaves forms, when roasted, an agreeable article of diet, and the leaves themselves are used as fodder for all kinds of cattle. A resin, known in commerce as *akaroid resin*, is obtained from all the species, which are also popularly known as black-boys.

Grass-wrack, or **Sea-grass** (*Zostera marina*), a plant belonging to the Naiadaceæ, forming green beds at the bottom of the sea where it is of no great depth. It is common enough on the British and European coasts, and when dried is used for stuffing mattresses and packing goods. The ash contains soda.

Gratian, otherwise **Franciscus Gratianus**, a Benedictine of the twelfth century, a native of Chiusi, and author of the *Decretum*, or, *Concordia discordantium Canonum*, a rich storehouse of the canon law of the Middle Ages.

Gratian, otherwise **Gratianus Augustus**, Roman Emperor, eldest son of the Emperor Valentinian I, was born A.D. 359, and when only eight years of age raised by his father to the rank of Augustus. On the death of Valentinian in 375 the Eastern Empire remained subject to Valens, and Gratian was obliged to share the western part with his half-brother, Valentinian II, then four years old. In 378 he succeeded to the Eastern Empire, which he bestowed on Theodosius I. He was deserted by his soldiers while leading them against Maximus, and put to death at Lyons in the eighth year of his reign.

Gratiola, a genus of plants, the hedge-hyssop genus, nat. ord. Scrophulariaceæ, containing about twenty species of herbs, widely dispersed through the extra-tropical regions of the globe. *G. officinalis* grows in meadows in Europe. It is extremely bitter, and acts violently both as a purgative and emetic, and in overdoses it is a violent poison.

Grattan, Henry, Irish orator and statesman, born at Dublin in 1746, died in 1820. Educated at Trinity College and Middle Temple, he was called to the Irish Bar in 1772, and in 1775 elected member for Charlton in the Parliament of Ireland. In 1780 he moved resolutions asserting the Crown to be the only link between Britain and Ireland, and in 1782 led the volunteer movement, which was instrumental in securing the concession of independence to Ireland. For these services the Irish Parliament voted him £50,000 and a house and lands. The corruption of its members and the uncertain relations with England resulted in the failure of 'Grattan's Parliament'. Grattan himself became opposed to the popular feeling as represented by the United Irishmen, and in 1797 temporarily seceded from Parliament, and lived in

retirement. In 1800 he came forward as member for Wicklow to oppose the Union, and on the passage of Pitt's measure was returned to the Imperial Parliament in 1805 for Malton in Yorkshire, and in 1806 for Dublin. He supported the war policy of the administration, but was afterwards chiefly occupied in promoting Catholic emancipation.—BIBLIOGRAPHY: A. E. Zimmern, *Henry Grattan*; W. E. H. Lecky, *Leaders of Public Opinion in Ireland*.

Gratz, or **Graz**, a town of Austria, capital of Styria, picturesquely situated on the Mur, 90 miles south-west of Vienna. The older town, on the left bank, is connected with the suburbs Lend and Gries on the right by several bridges, besides a railway bridge. The Schlossberg rises 400 feet above the river, but the fortifications of the town have given place to avenues and pleasure-grounds. The cathedral of St. Ægidius, built in 1456, is a majestic Gothic structure with a fine altar and paintings; near it is the mausoleum of Ferdinand II. The university, founded in 1573, has over 2000 students and a library of 80,000 vols. The Joanneum, for the promotion of agriculture and scientific education, has a large library and museums. The manufactures consist of woollen, cotton, and silk tissues, machinery, steel, rails, wagons, soap, leather, and ironware. Pop. 157,032.

Graudenz (grou'dents), a town of Poland, formerly in Western Prussia, on the right bank of the Vistula, 18 miles s.s.w. of Marienwerder. The manufactures include machinery, castings, cigars, tobacco, brushes, &c., and there are several breweries and distilleries. The fortress of Graudenz, constructed by Frederick the Great (1722-6), was dismantled in 1874. During the European War Graudenz was seriously threatened by the first Russian advance in 1914. Pop. 40,325.

Gravelines (gräv-lën), a small seaport and second-class fortress, France, department of Nord. It suffered from German air-raids in 1915. The battle of Gravelines, between the English and the Spaniards on one side, and the French on the other, was fought in July, 1558. Pop. 5890.

Gravelotte (gräv-lot), a village of France, in Alsace-Lorraine, 7 miles west of Metz, the scene of one of the fiercest battles of the Franco-German War (18th Aug., 1870), resulting in the retreat of the French to Metz.

Gravesend, a municipal borough of England, in Kent, on the south bank of the Thames, 21 miles east of London. It is a great rendezvous for shipping, the boundary port of London, and troops and passengers frequently embark there to avoid the passage down the river. There is some trade in supplying ships' stores, and boat-building and iron-founding are carried on. A

parliamentary borough until 1918, Gravesend now gives name to one of the eleven parliamentary divisions of the county. Pop. 31,137.

Graví'na, a town of South Italy, province of Bari, on the Gravina. It has a cathedral and a college. Pop. 19,900.

Gravitation, the force by reason of which all the bodies and particles of matter in the universe tend towards one another. According to the law of gravitation discovered by Newton, every portion of matter attracts every other portion with a force directly proportional to the product of the two masses, and inversely proportional to the square of the distance between them. Kepler had given the laws, deduced from observation, according to which the planets describe their orbits. From these Newton deduced the laws of the force in the case of the planets; and subsequently he generalized the statement of them, by showing the identity of the nature of the force that retains the moon in her orbit with that which attracts matter near to the surface of the earth. The application of the grand law that he had discovered constituted a large part of Newton's mathematical work. Attacking the problem of *lunar inequalities*, he accounted for them by considering the perturbations due to the attraction of various bodies of the solar system; and, by accounting for all the observed perturbations by means of his newly-discovered law, he confirmed the truth of the law itself in such a way as to put it beyond all question. The computation of these various attractions has reached such a degree of accuracy in the hands of mathematicians since Newton that the most complicated motions of the heavenly bodies can be predicted.

Theories of Gravitation.—Many theories have been given to account for gravitation. The difficulty with any particular theory is to bring it to an experimental test. One theory is that gravitation is a residual effect of electrostatic or electromagnetic forces. A remarkable theory was given by Le Sage of Geneva in 1818. He pictured the universe as filled with minute particles (*ultra-mundane corpuscles*) moving at great speeds in all directions. These particles can pass through dense matter, but not with perfect freedom, some being absorbed and giving up their momentum. A single body in free space is bombarded equally in all directions, and therefore not affected; but two bodies partially screen each other, and are attracted. Le Sage proved that Newton's law followed from this theory. Lord Kelvin showed that gravitation could be explained by the hypothesis of an infinite fluid in which bodies are either all sources or else all sinks, producing or absorbing the fluid at rates proportional to their masses. See *Geodesy*; *Gravity*; for Einstein's Theory, see *Relativity*.

Gravity. Newton's law of gravitation tells us that any two masses attract each other with a force which acts in the line joining them, and which is directly proportional to their masses and inversely proportional to the square of the distance between them. We know further that the materials of which the masses are composed have no bearing on this law, and that the mass of any body is defined by its volume and its density. As an illustration of the magnitude of this force, two weights of, roughly, 23,300 tons, at a distance from each other of 100 yards, attract each other with a force of 1 pound.

Consider the effect of this law upon the planetary system. The sun and the planets are all roughly spherical, and their attractions act from their respective centres, where their masses may be considered to be concentrated. If M_s be the mass of the sun, M_p that of any planet, and d the distance between them, then the force acting on this planet is proportional, by Newton's law, to $M_s \times M_p \div d^2$. Astronomical observation confirms this law, for it shows that planets revolve round the sun in ellipses, with the sun in one focus, and at such speeds that the line joining the sun and planet sweeps out equal areas in equal times. Naturally the movement of planets in space is affected also, and in due proportion, by the force of gravitation exerted upon them by other planets, or by their own satellites. Such irregularities are known as perturbations, and their observed magnitudes correspond sufficiently closely to those calculated by Newton's law. Now the dimensions, movements, and relative positions of the planets are known from observation, and consequently their relative densities can be calculated. In order, then, to provide a common measure, we must find the density of the earth in terms of some known unit.

To find the density of the earth we must compare the attraction it exerts upon any body with the attraction exerted on this same body by some other body of known mass. This second body may be a mountain, as in Maskelyne's famous experiment of 1774 at Schiehallion in Perthshire, or it may be a leaden weight, as in the long list of laboratory experiments starting with Cavendish, in 1797, and ending with Poynting's recent work. In the former class of experiment the mass and form of the mountain must be determined by careful survey and analysis of composition. Let M represent the mountain and its mass, E the earth's mass, A a point of observation near the mountain, O the centre of the earth, S distance AM , R the radius of the earth. Then the attractions of the mountain mass and of the earth upon the plumb-bob are as M/S^2 is to E/R^2 . If the

plumb-bob is attracted towards the mountain through an angle α , then $\tan \alpha = (M/S^2) \div (E/R^2)$. Now $E = \frac{4}{3}\pi R^3 \Delta$ where Δ is the density of the earth, and $M = V\delta$ where δ is the density of the mountain, and V its volume. If M, S, R, α are known, the value of Δ can be calculated.

Although Maskelyne's experiment, and a similar one carried out by Sir Henry James, at Arthur's Seat, near Edinburgh, gave results for Δ which are singularly near the truth, this method is not a precise one, because it is difficult to assess the density and consequent mass of any topographical feature.

Another form of the same experiment is to swing a pendulum at the surface of a mine, and

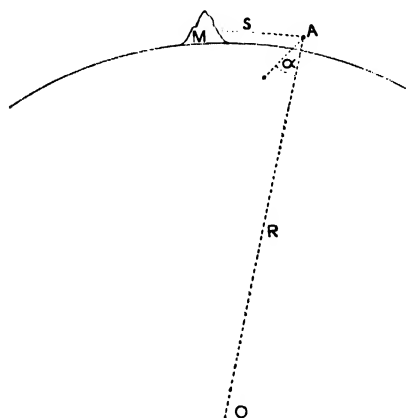


Fig. 1

subsequently at some depth in that mine. We can think of the earth as having a layer skinned off to the depth of the lower point of observation, and if we then assess the density of the top layer, we can find the density of the remaining mass of the earth in much the same way as before. An interesting experiment on these lines was carried out by Airy in 1854, at Harton coal-pit, and later by Von Sterneck, in Saxony and Bohemia.

The second method of comparing the attraction of the earth with that of a known and small mass was due to Cavendish. His apparatus consisted of two small leaden balls on the ends of a straight rod which was suspended by a fine wire. (In the most recent experiments on these lines a quartz fibre wire has been used.) Two larger leaden spheres were brought close to the lead balls on opposite sides of the rod, to attract them and cause the rod to rotate slightly. The large spheres were then turned round, acting upon the same respective sides of the rod, but attracting the opposite balls and causing the

rod to swing back again. Now if we know the masses of balls and spheres, the torsion couple of the wire, and the length of the rod, we can find the force of attraction acting on either of the small balls. But we know the attraction of the earth for this ball, viz. the weight of the ball. We can therefore find Δ , the density of the earth, by the same kind of calculation as in the mountain experiment. Many experiments have been made with this general idea, and the names of Baily, Reich, Cornu, Baille, Boys, and Braun are famous in this connection. Poynting's experiment is of a slightly different order, inasmuch as he uses a strong type of balance, instead of a torsion couple, and one leaden sphere on a turn-table below the pans of the balance, as his attracting mass.

These experiments have served to give us a number of values for the magnitude of the two factors, Δ the density of the earth, and G the gravitation coefficient (which is the constant in the expression: attraction = MM'/d^2). We may accept the following values as close approximations to the truth:

$$\Delta = 5.5 \text{ times that of water.}$$

$$G = 6.658 \times 10^{-8} \text{ c.g.s.}$$

We must now turn from gravitation to gravity, which is indeed but a special case of gravitation, and yet is perhaps of the greater importance. If the earth were a homogeneous sphere at rest, the attraction would be the same at all points on the surface. It rotates, however, upon its polar axis, and in so doing introduces the element of centrifugal force. The centrifugal force per unit mass at any spot is equal to $x\omega^2$, where x is the distance from the axis, and therefore = $R \cos \lambda$ (λ being the latitude), and ω is the angular velocity of rotation. The centrifugal force acts as diminishing the attraction of the earth, and varies as the cosine of the latitude, vanishing at the poles and reaching its maximum at the equator. Now by virtue of the earth's attraction, any body at a height above the earth, and free to do so, will fall to the earth, and in doing so will, after a fall of 1 second in duration, acquire a certain velocity, which is commonly known as g . g is independent both of the mass and of the material of the body in question, but is dependent upon the attraction of the earth at that place, and is therefore a measure of gravitation—centrifugal force. Of these two, centrifugal force is always so much the smaller that whilst $g = 978.024$ centimetres per second per second at the equator (its minimum), its maximum value at the poles is only 983.210 cm./sec.². From the above it is clear that the weight of a body depends upon g , and that its actual value will change from a maximum

at the pole to a minimum at the equator. It is still true that the masses of two or more bodies are proportional to their own weights at the same spot. In the above discussion on g it has been assumed that the earth is a perfect figure of revolution. In practice it is not so, however. We have inequalities of height, and, as we have already seen, the force of gravitation, and hence of gravity, is affected by the distance from the centre of the earth.

The earliest experiments made with a view to determining the acceleration of a falling body were those of Galileo in the sixteenth century, but the most striking step in gravity experiment was the pendulum clock produced in 1657 by Huygens. The theory of the pendulum is

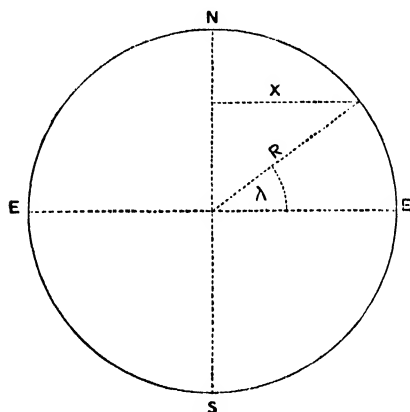


Fig. 2

briefly as follows: If a weight be hung by a thread and set vibrating, then if t be the time of one swing from rest to rest, and l be the length of the thread, then $t = \pi \sqrt{l/g}$, or $g = \pi^2 l/t^2$. The pendulum only obeys this theoretical law in a vacuum, for the actual weight of the air displaced by the pendulum, and its resistance to the vibration, introduce errors. During the history of pendulum experiment from the seventeenth century to the present day, the design of the pendulum has been successively improved by Newton, Bouguer, Borda, Cassini, Kater, Bessel, Repsold, and others. The types now employed are used for relative determination rather than actual. It is difficult to measure the length of the pendulum rod with sufficient accuracy to ensure a good determination of g . It is due to Clairaut, however, that we know how to use the pendulum relatively, and, from a series of observations, to arrive at the ellipticity of the earth. If L be the length of a seconds pendulum at the equator, and l its length at any latitude λ , m the ratio

of centrifugal force at the equator to gravity, and e the ellipticity of the earth, then

$$l = L[1 + (\frac{1}{2}m - e) \sin^2 \lambda].$$

Modern pendulums are generally of the half-seconds type, that is to say, of such a length that the time of one swing is approximately half a second. The support is made as rigid as possible to eliminate the error due to its flexure. The pendulum rod is supported on a knife-edge, which is generally an integral part of the rod, but is occasionally, as in the United States Coast and Geodetic Survey pattern, on the support. The whole instrument is placed in a case from which the air can be exhausted. It is kept at a standard temperature, and the time of vibration is compared with chronometer signals. We secure then systems of comparative observation over large areas, which are gradually connected up into a homogeneous whole, and we may say that the value of g is accurately known over wide areas. (Cf. *Physical and Chemical Constants*, Kaye and Laby.)

The best mean value of the ellipticity of the earth derived from recent pendulum experiments may be taken as $1/298.3$ (Helmert). One matter of great importance in pendulum experiment has not yet been mentioned. Results must be reduced to the corresponding figure at mean sea-level in order to make comparison possible. Now this reduction has been made in various ways. In all cases the decreased distance from the centre of the earth has been allowed for. Bouguer allowed also for the additional attraction due to the mass above mean sea-level, as if this mass were independent of the general configuration and density of the earth. In the 'free air' method this additional attraction is omitted altogether, and the use of the isostatic method implies that the mass above mean sea-level is not a completely independent factor, but is compensated for by underlying portions of deficient density (see *Isostasy*), a conclusion which is now generally accepted.

Mention must also be made of Threlfall and Pollack's quartz-thread gravity balance, and of the torsion balance used by Baron Eötvös in Hungary. Experiment indicates that considerable accuracy may be obtained by statical methods such as these, but we have as yet little observed result to go upon. Those interested in the subject will find details of Threlfall's balance in *Philosophical Transactions* for 1900. —BIBLIOGRAPHY: A. R. Clarke, *Geodesy*; F. R. Helmert, *Höhere Geodäsie*; Poynting and Thomson, *Physics: Properties of Matter*; the technical papers of the Survey of India, and of the United States Coast and Geodetic Survey.

Gray, Asa, American botanist, born 1810,

died in 1888. He was appointed Fisher professor of natural history in Harvard University in 1842, and held the chair till 1873, when he retired from its more active duties. His works include: *Elements of Botany* (1836), *A Manual of Botany* (1848), and other botanical textbooks; also portions of works on the flora of North America and the Genera Boreali-Americana, a *Free Examination of Darwin's Treatise* (1861), and a volume entitled *Darwiniana* (1876).

Gray, David, Scottish poet, born at Merkland, Dumbartonshire, in 1838; studied at Glasgow University, from which he went, with Robert Buchanan, to London in 1860 to try his fortune in literature. After a brief struggle consumption set in, and he died at Merkland in 1861. A small volume containing the poem entitled *The Luggie*, some lyrics, and a few sonnets, with the title *In the Shadows*, represents the whole of his work.

Gray, Thomas, English poet, was born on the 26th Dec., 1716, and died on the 30th July, 1771. His mother had twelve children, of whom he alone grew up. His father was what we call on the Stock Exchange; he was a man of violent temper and a bad husband and father. Gray was sent to Eton in 1727; he was already of a studious disposition, and was shy and sensitive. In 1734 he entered Peterhouse, Cambridge, where his maternal uncle had been a fellow. He did not graduate at the normal time, and though he studied hard he seems to have followed no regular plan. He particularly disliked mathematics, but read Greek, Latin, French, and Italian voraciously, and had a passion for accurate knowledge in such subjects as entomology and botany. He left Cambridge in 1738, and during the next year went a tour on the Continent with Horace Walpole, who had been his friend at Eton and Cambridge. It is typical of the scholarly bent of his mind that he studied the *De Bello Gallico* as he travelled through France, "Cæsar's visens monumenta magni". Livy and Silius Italicus accompanied him as he crossed the Alps. He eventually quarrelled with Walpole, and continued his travels alone. In 1741 he visited the Grande Chartreuse, and left behind him a beautiful poem in Latin alcaics, commencing "O tu severi religio loci". He returned to England in the same year, and spent some time in London. In 1742 he produced, for him, a considerable amount of poetry—some of it fragmentary, as the ambitious *De Principiis Cogitandi*, a poem which attempted to render Locke into Lucretian Latin, and *Agrippina*, a tragedy; but some of it completed, such as the *Ode on a Distant Prospect of Eton College*, and the *Hymn to Adversity*. In 1742, through lack of a more definite occupation,

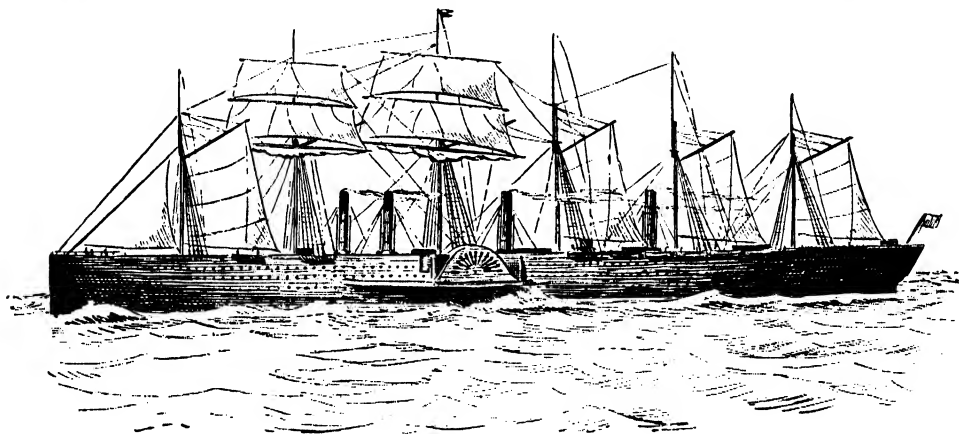
he returned to Peterhouse. He was destined to spend most of the rest of his life at Cambridge, although he never held a fellowship. In 1744 he proceeded to the degree of M.A. The rest of Gray's life was uneventful. In Feb., 1751, he published the famous *Elegy*; it had probably been begun some seven years previously, but the work of polishing it was very slow. He would not have published it even when he did had it not been impudently pirated. *The Progress of Poesy* and *The Bard* were published in 1757. In 1756 Gray migrated to Pembroke College, on account of a practical joke played upon him by some of the fellow-commoners of Peterhouse. The story of this joke, like the report of Mark Twain's death, would seem to be grossly exaggerated, but it is still a living legend at Cambridge. During the last years of his life Gray became rather less sedentary in his habits, and went several long walking tours, visiting Scotland, Yorkshire, the English Lakes, Derbyshire, and the neighbourhood of Southampton. To his credit Gray had declined the offer of the Laureateship in 1757, so that the mantle of Colley Cibber fell upon William Whitehead. In 1768, however, he accepted the chair of modern history at Cambridge. The post was a sinecure, and although he intended to lecture he did not do so. He took ill in hall on 24th July, 1771, and died of gout in the stomach six days afterwards.

Gray is perhaps the least productive of all the greater English poets. No man has won so large a reputation with so small an amount of work. There are several causes to account for his sterility. He seldom enjoyed robust health, and seems to have lived in a state of gentle melancholy. He was not obliged to work for his living. One of his favourite maxims was "to be employed is to be happy", and he himself was never adequately employed. Moreover, Cambridge in those days was not an exhilarating place; many of the dons found their sole recreation in bickering with each other, and many were lacking not only in learning but in any desire to learn. Perhaps, however, the main cause of Gray's sterility was the great load of learning which he bore. He was reputed to be the most learned man in Europe. He was probably the best Greek scholar at Cambridge between Bentley and Porson. He knew the literature and history of England, of France, and of Italy. He was interested in criticism, metaphysics, morals, and politics; he had a fine taste in painting, prints, architecture, and gardening. He excelled in his knowledge of botany, zoology, and entomology. He was also a good musician. All this learning tended to make him over-fastidious in his writings. A brain which is continually receiving cannot create much. So

Gray's poems occupy a few pages only in any collection, and yet they are among the best poems of their kind in English. They are, perhaps, too highly polished, and give an impression of cold perfection. It was not for nothing that he composed so much Latin verse; he would seem to have written English verse somewhat on the same principles, restlessly searching for exactly the right word. The *Elegy* is popular because it contains much commonplace thought more exquisitely expressed than it had been before, or is ever likely to be. The two Pindaric odes are not unlike Pindar; preceding writers, in attempting this form of

Europe from Lapland to North Italy, and there are allied species in Asia and North America. It smells like thyme, hence the generic name. The grayling prefers rapid streams where the water is clear and cool, and the bottom sandy or pebbly, and it requires on the whole deeper water than the trout, to which it has a certain similarity in habit. The general colour is yellowish-brown, including the fins; several deeper brown lines run along the body; under the belly it is white. The colour often varies in different streams. It is a favourite fish of the angler.—Cf. T. E. Pritt, *The Book of the Grayling*.

Grays Thurrock, a town of England, Essex,



The Great Eastern

composition, had produced something that Pindar would have vehemently disowned.

No account of Gray would be complete without a mention of his delightful letters. In them we can read the whole story of his life. They are infinitely various. Were it not for them we should not know for certain that he possessed that gentle spirit of humour which is often complementary to a gentle spirit of melancholy. They are full of scholarship, wisdom, and wit in the best sense of the word.

Gray's friend Dr. Wharton, writing of the poet a fortnight after he died, said of him: "He never spoke out". These words exactly describe Gray's character, as a man and as a poet. His scanty writings, however, will live as long as English is spoken.—BIBLIOGRAPHY: E. Gosse, *Gray* (English Men of Letters Series); D. C. Tovey, *Gray and his Friends*; *Gray's Letters*, edited by D. C. Tovey.

Grayling, a genus of fishes of the family Salmonidæ. The common grayling (*Thymallus vulgaris*) is found in many English streams, and also in some in Scotland. It is scattered over

on the Thames, on the railway to Tilbury and Southend. Pop. 17,364.

Graywacke (grā-wak'e), a strongly-cemented sandstone in which grains or fragments of various minerals, as quartz and felspar, or of rocks, as slate and siliceous clay rocks, are embedded in an indurated matrix, which may be siliceous or argillaceous. The colours are grey, red, blue, or some shade of these. The term, as used by the earlier writers, included all the conglomerates, sandstones, and shales of the older formations, when these had been subjected to considerable change. At first it was nearly synonymous with the Silurian strata, these, especially in Scotland, yielding the only genuine graywacke. The term, now little used, originated in the Ger. *grauwacke*.

Great Circle Sailing, or **Tangent Sailing**, a method of navigating a vessel according to which her course is always kept as nearly as possible on a great circle of the sphere, that is, a circle which has for its centre the centre of the sphere. An arc of such a circle joining two places gives the shortest distance between them, consequently the course of a vessel sailing on

this arc will be the shortest possible. A simple instrument called a spherograph is employed for finding the great circle course between places, and this is accompanied by tables compiled for the same purpose.

Great Eastern, an iron steamship, the largest vessel of her time, built (1854-8) at Millwall, on the Thames, for the Eastern Steam Navigation Company, by Scott Russell, from plans by I. K. Brunel; length, 680 feet; breadth, 82½ feet, or, including paddle-boxes, 118 feet; height, 58 feet (70 to top of bulwarks). She had six masts, five of iron and one of wood, and could spread 7000 sq. yards of sail, besides having eight engines, divided between her screws and paddles, and capable of working at 11,000 horse-power. From the first her career was unfortunate, the launching process alone lasting three months and costing £60,000. After several unremunerative trips to New York she was employed first as a troopship, and then as a cable-laying ship, for which her size and steadiness specially qualified her. Various attempts were afterwards made to utilize her, but she at last came to be a mere holiday spectacle, and was broken up in 1888, the materials being sold for about £60,000. An equal in size of the *Great Eastern* was not produced until 1901, when the *Celtic* was built.

Great Fish River, a river of South-East Africa, near the eastern frontier of Cape Province. It rises in the Snowy Mountains, and falls into the sea after a course of 230 miles.

Great Fish or Back River, a river of Northern Canada, rising in Sussex Lake, and flowing, after a course of about 500 miles, into Cockburn Bay, an inlet of the Arctic Ocean; discovered by Sir George Back.

Great Marlow, a town of England, county of Bucks, on the Thames, 5 miles N.N.W. of Maidenhead. Manufactures: chairs, lace, and paper. Pop. 5146.

Great Salt Lake, a lake, United States, state of Utah, 4000 feet above sea-level, 70 miles in length north to south and 48 miles east to west. Five gallons of its water yield, by evaporation, 14 pints of salt. It has several islands, which, with its shores, are whitened by the salt; and it receives the Bear, the Utah, and several other streams. It contains no fish, but has several species of insects and a crustacean, and is frequented by immense flocks of gulls, ducks, geese, and swans.

Grebe, the common name of the birds of the genus *Podiceps* and allied genera, family Podicipidæ, characterized by a straight conical bill, no tail, tarsus short, toes flattened, separate, but broadly fringed at their edges by a firm membrane, and legs set so far back that on land the grebe assumes the upright position of the penguin. The geographical distribution

of the genus is very wide, these birds haunting seas as well as ponds and rivers. They are excellent swimmers and divers; feed on small fishes, frogs, crustaceans, and insects; and their nests, formed of a large quantity of grass, &c., are generally placed among reeds and sedges, and rise and fall with the water. Five species are British, the great crested grebe (*P. cristatus*), the little grebe or dabchick (*P. fluviatilis*), the Slavonian or horned grebe (*P. auritus*), the red-neck (*P. griseigena*), and the rare eared-grebe (*P. nigricollis*). The last three are winter visitors, but the first two remain all the year.



Great Crested Grebe (*Podiceps cristatus*)

A number of species are North American, some of these (crested grebe, horned grebe) being the same as those of Europe. The great crested grebe, which ranges across the Old World to New Zealand, is about 21 to 22 inches long, and has been called satin grebe from its beautiful silvery breast-plumage, much esteemed as material for ladies' muffs.

Greco, El, the name usually given to Domenico Theotocopuli, Spanish painter, born in Crete about the middle of the sixteenth century, died at Toledo 1614. He studied and worked first in Venice, and his early work shows the influence of the Venetian school, especially Tintoretto and Bassano. He settled at Toledo some time before 1577, and shortly afterwards painted the *Disrobing of Christ*, now in the cathedral there. Later appeared one of his masterpieces, *The Burial of the Count of Orgaz*,

followed by a series of altar-pieces, single figures of saints (including several versions of S. Francis), portraits, and a few landscapes. Soon after his arrival in Spain, El Greco threw off Italian influence and developed a very individual art, reflecting a singularly vehement and passionate temperament, and marked by the use of swinging rhythmic curves and arbitrary distortions of the human figure. His colour in later years is remarkable for its use of cold, steely greys, combined with vivid and harsh, but very expressive colour. He is well represented in the National Gallery by the recently acquired *Agony in the Garden*.

Greece, a republic of South-Eastern Europe, the earliest portion of this continent to attain a high degree of civilization, and to produce works of art and literature as yet unsurpassed. It consists of the southern part of the Balkan Peninsula and of numerous islands, Eubœa, N. Sporades, Cyclades, Crete, Ionian Islands, &c. It is bounded on the north by Albania, Yugo-Slavia, and Bulgaria; on the east by the Black Sea, the Sea of Marmara, the Dardanelles, and the Ægean Sea; on the south by the Mediterranean; and on the west by the Ionian Sea. As a result of the war with Turkey (1912-3), with Bulgaria in 1913, and of the European War, Greece has increased her territory considerably. In 1914 the total area of Greece was about 42,000 sq. miles, with a population of 4,820,000. As a result of the European War, and of the Treaty of Sèvres with Turkey, it was decided by the Great Powers that Greece would obtain all that was left of Turkey in Europe west of the Chatalja lines, and also Western Thrace. The war with Turkey (1921-2) ended, however, in the complete overthrow of the Greek forces. At the Conference of Lausanne (1922-3) it was agreed to return to Turkey the whole of Eastern Thrace up to the Maritsa line, thus practically reverting to the old frontier of the Treaty of Constantinople. The present area is 49,022 sq. miles.

The name *Greece* (Lat. *Græcia*) is of Roman origin, the native name for the country being *Hellas*, and the people calling themselves *Hellènes*. Anciently *Hellas* was used in a wider sense, so as to include both Greece itself and all countries that had become Greek by colonization. Ancient Greece was divided into a number of independent states or territories, namely, in Northern Greece, Thessaly, Epirus, Locris, Phocis, Boeotia, Ætolia, Acarnania, Attica, Megaris; in the Peloponnesus, Corinth, Argolis, Achaia, Elis, Messenia, Laconia (Sparta), and Arcadia, the last entirely inland. These names are still kept up, but the country is now divided into nomes, some of which are formed of the Greek islands, namely, Eubœa, Corfu, Cephalonia, Zante, Leucadia, and the Cyclades.

Physical Features.—Greece proper is remarkable for the extent of its coast-line, formed by numerous gulfs which penetrate into it in all directions. The largest, the Corinthian Gulf, or Gulf of Lepanto, on the east, and the Saronic Gulf, or Gulf of Ægina, on the west, which nearly meet at the Isthmus of Corinth, separate Northern Greece from the Morea. Another striking feature is the mountainous character of the interior. On the north are the Cambunian Mountains, with Mount Olympus (9754 feet) at their eastern extremity. From this range a lofty chain, called Mount Pindus, runs southwards almost parallel to the eastern and western coasts of Greece. At a point in this chain called Mount Tymphrestus or Typhrestus (Mount Velukhi) two chains proceed in an easterly direction, the northern being called Mount Othrys, the southern terminating at Thermopylæ, Mount Cæta (8240 feet). The Cambunian Mountains, Pindus and Othrys, enclose the fertile vale of Thessaly, forming the basin of the Peneus (Salambría), and the ranges of Othrys and Cæta enclose the smaller basin of the Sperchius (Hellada). Another range, that of Parnassus (highest summit 8068 feet), branches off from Mount Cæta and runs still more to the south. The peaks of Cithæron, Parnes, Pentelicus, and Ilymettus lie in the same direction, and the range in which they are found is continued to the south-east point of continental Greece. This range on the south and that of Cæta on the north enclose the basin of the Cephissus, with Lake Copais. The chief rivers on the west side of the Pindus chain are the Arachthus (Arta) and the Achelôus (Aspropotamo). The chief feature in the mountain system of the Peloponnesus is a range or series of ranges forming a circle round the valley of Arcadia in the interior, having a number of branches proceeding outward from it in different directions. The highest range in the Peloponnesus, Mount Taygetus (7904 feet), branches off from the circle round Arcadia, strikes southwards, and terminates in the promontory of Tanarum (Cape Matapan). The chief rivers in the Peloponnesus are the Eurotas (Basilipotamo), the Alpheus (Ruphia), draining Arcadia and Elis; and the Peneus, draining Elis. The rock most largely developed in the mountains of Greece is limestone, which often assumes the form of the finest marble. Granite occurs in patches. Tertiary formations prevail in the north-east of the Peloponnesus; and in the north-west, along the shores of Elis, are considerable tracts of alluvium. Silver, lead, zinc, and copper are found and worked to some extent, the famous ancient silver-mines of Laurium in Attica still yielding a little of the precious metal, but chiefly lead, iron ore, and zinc.

Climate.—The climate is generally mild, in the parts exposed to the sea equable and genial, but in the mountainous regions of the interior sometimes very cold. None of the mountains attain the limit of perpetual snow; but several retain it far into the summer. In general the first snow falls in October and the last in April. During summer rain scarcely ever falls, and the channels of the minor streams become dry. Towards the end of harvest rain becomes frequent and copious; and intermittent fevers become common. In ancient times, when the country was more thickly peopled and better cultivated, the climate seems to have been better.

Vegetation, Agriculture, &c.—Greece is mainly an agricultural country, and the economic life of the country depends on the products of the soil. The land is largely held by peasant proprietors. The principal crops are wheat, barley, and maize. The cultivated land produces all the fruits of the latitude—figs, almonds, dates, oranges, citrons, and melons. The vine also grows vigorously, as it did in ancient Greece. But a much more important product of Greece, especially on the coasts of the Peloponnesus, and in the islands of Cephalonia, Zante, Ithaca, and Santa Maura, is the Corinthian grape or currant. The olive is also largely grown (as in ancient times), and the culture of the mulberry, for the rearing of silk-worms, has been greatly extended. The extensive forests contain among other trees a peculiar kind of oak (*Quercus Ægilops*), which yields the valonia of commerce. The domestic animals are neither numerous nor of good breeds. Asses are almost the only beasts of burden employed; and dairy produce is obtained from the sheep and the goat.

Manufactures, Trade, Communications, &c.—The manufactures are extremely limited, but with all other branches of industry in Greece are increasing. They include cottons, woollens, earthenware, and leather; and shipbuilding is carried on largely at various points of the coast, and at the Piræus. In 1920 the mercantile marine of Greece had an aggregate burden of about 298,903 tons. A large part of the shipping of Greece is engaged in the carrying trade between Britain, Germany, &c., and Greece, Turkey, and other Mediterranean countries. The chief ports are Corfu, Syra, Piræus (the port of Athens), and Patras. The principal exports are currants and olive-oil; but valonia, emery, silk, dried figs, raisins, honey, wax, lead, tobacco, and other articles are also exported; the principal imports are cereals, and cotton, woollen, and silk goods, sugar, iron goods, and coffee. The greatest hindrance to the development of Greece at the present time is the want of good roads, but that is being gradually remedied. A canal across the Isthmus of Corinth was completed in 1893.

In 1883 there were only 58 miles of railways open, but in 1920 there were 1507 miles opened, besides lines under construction. The telegraph lines were of a total length of 9840 miles. The money unit of Greece is the *drachma* of 100 *lepta*, which is nominally 1 franc.

Constitution, &c.—A plebiscite taken throughout Greece in 1924 resulted in a majority for the establishment of a republic. Accordingly a National Assembly was elected and entrusted with the task of drawing up a republican constitution. When King Georgios II fled in Dec., 1923, Admiral Konduriotis became provisional head of the State, and then first president of the republic. He resigned in March, 1926, and was succeeded by General Pangalos, who had been virtually dictator since June, 1925. In August, 1926, General Kondylis overthrew Pangalos and Konduriotis again became president. The Greek Church alone is established, but all forms of religion enjoy toleration. Justice is administered, on the basis of the French civil code, by a supreme court (*Areios Pagos*), at Athens; four courts (*Ephiteia*), at Athens, Nauplia, Patras, and Corfu; sixteen courts of primary resort (*Protodokeia*), one in each principal town. The public revenue, derived chiefly from customs, land tax, tobacco and petroleum monopoly, state domains and national property, &c., amounted in 1914 to £22,685,909, and in 1921 to £51,950,390. All able-bodied males are liable to military service from the age of twenty-one, the periods being two years in the active army, ten in the reserve, eight in the national guard, and ten in the national guard reserve. The expenditure for 1914 and 1920 respectively was £22,210,410 and £61,692,029. The annual contingent of recruits for the army, as fixed by Parliament, is about 25,000. In 1920 the strength of the Greek army was 200,000 men. The Greek navy was reorganized in 1906, and consists of seven iron-clads, thirteen destroyers, six modern torpedo-boats, and a number of other vessels.

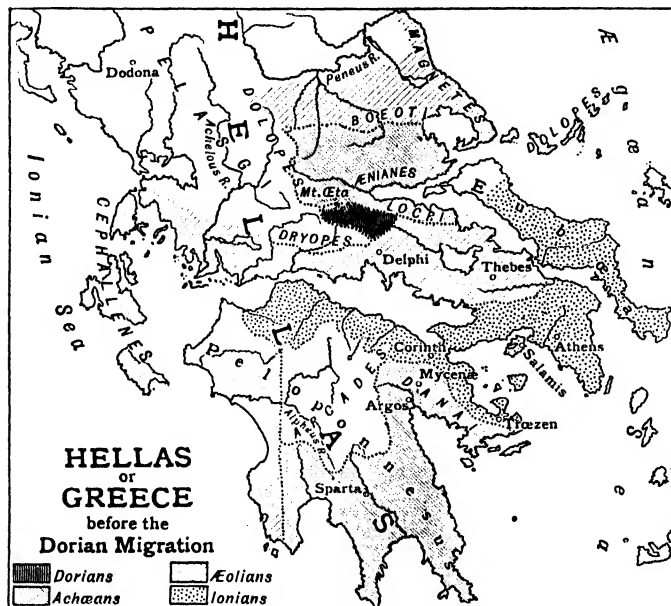
People.—The ancient Greeks were an Aryan race, probably most closely akin to the Italian peoples. They were noted for physical beauty and intellectual gifts. The present population contains a considerable intermixture of foreign stocks, among which the Albanese, or Arnauts, are the most numerous; but the great majority, though not without some taint in their blood, are of Greek extraction. Education in Greece is free and compulsory in theory (from the age of six to twelve), but a large proportion of the people can neither read nor write. There are three grades of schools, the primary national schools, the Hellenic or secondary grammar-schools, and the gymnasia, which are higher grammar-schools or colleges. In addition there

are two universities at Athens, the National University, founded in 1836, and the Capodistria University. The national dress of the Greeks resembles the Albanian costume. In the men it consists of a tight jacket, generally scarlet, wide trousers descending as far as the knee, and embroidered gaiters; in the women it consists of a close-fitting vest, and a gown flowing loosely behind.

History.—The earliest inhabitants of Greece were the Pelasgians, of whom little or nothing is known with certainty. To them are attributed

cleidæ' (descendants of Hercules), placed by Thucydides about eighty years after the fall of Troy, or about 1104 B.C., according to the ordinary chronology. Before the great migration several smaller ones had taken place, causing considerable disturbance; and at last the hardy Dorian inhabitants of the mountainous region about Mount Ceta conquered a large part of Northern Greece, and then entered and subdued the greater part of the Peloponnesus, driving out or subjugating the Achæans, as the Achæans had the Pelasgians. In the legend the Dorians are

represented as having entered the Peloponnesus under Temenus, Cresphontes, and Aristodemus, three descendants of Heracles (Hercules), who had come to recover the territory taken from their ancestors by Eurystheus. Of the Achæan inhabitants of the Peloponnesus a large section occupied the territory formerly in possession of the Ionians, henceforward called Achaia. The Ionians driven out of the Peloponnesus found at first a refuge among their kindred in Attica, but owing to its limited territory were soon compelled to leave it and found Ionic colonies on several of the islands of the Ægean Sea and on the middle part of the coast of Asia Minor, where they built twelve cities, afterwards forming an Ionic Confederacy. The principal of these were Ephesus and Miletus.



certain remains of ancient buildings, especially the so-called Cyclopean works in the Peloponnesus. The Pelasgians were succeeded by the Hellènes, or Greeks proper, who may have been simply one of the Pelasgian tribes or races. To the early period of the Hellenic occupation of Greece belong the legends of the Trojan War, of Theseus, of Jason and the Argonauts, &c. The Hellènes were divided into four chief tribes—the Æolians, occupying the northern parts of Greece (Thessaly, Bœotia, &c.); the Dorians, occupying originally a small region in the neighbourhood of Mount Ceta; the Achæans, occupying the greater part of the Peloponnesus; and the Ionians, occupying the northern strip of the Peloponnesus and Attica. Of the four principal tribes the Ionians were most influential in the development of Greece. The distribution of the Hellenic tribes was greatly altered by the Dorian migration, sometimes called 'the return of the Hera-

About the same time another body of Greeks, from Thessaly and Bœotia, are said to have founded the Æolian colonies on some of the northern islands of the Ægean, and on the northern part of the western coast of Asia Minor. The Æolic colonies of Asia Minor also formed a confederacy of twelve cities, afterwards reduced to eleven by the accession of Smyrna to the Ionic Confederacy. The southern islands and the southern part of the west coast of Asia Minor were in like manner colonized by Dorian settlers. The six Doric towns in Asia Minor, along with the Island of Rhodes, formed a confederacy similar to the Ionic and Æolic ones.

In course of time many Greek settlements were made on the coasts of the Hellespont, the Propontis (Sea of Marmora), and the Black Sea, the most important being Byzantium (Constantinople), Sinope, Cerasus, and Trapezus

(Trebizonde). There were also flourishing Greek colonies on the coasts of Thrace and Macedonia; for example, Abdera, Amphipolis, Olynthus, Potidæa, &c.; and the Greek colonies in Lower Italy were so numerous that the inhabitants of the interior spoke Greek, and the whole region received the name of Greater Greece (*Magna Græcia*). The most famous of the Greek colonies in this quarter were Tarentum, Sybaris, Croton, Cumæ, and Neapolis (Naples). Sicily also came to a great extent into the hands of the Greeks, who founded on it or enlarged many towns, the largest, most powerful, and most highly cultured of the Greek colonies here being the Corinthian colony of Syracuse, founded in the eighth century B.C. Other important colonies were Cyrene on the north coast of Africa, and Massilia (Marseilles) on the south coast of Gaul. All these colonies as a rule preserved the customs and institutions of the mother city, but were quite independent.

Although ancient Greece never formed a single state, the various Greek tribes always looked upon themselves as one people, and classed all other nations as *Barbaroi* (foreigners). There were four chief bonds of union between the Greek tribes. First and chiefly, they had a common language, which, despite its dialectic peculiarities, was understood throughout all Hellas or the Greek world. Secondly, they had common religious ideas and institutions, and especially, in the oracle of Delphi, a common religious sanctuary. Thirdly, there was a general assembly of the Greeks, the Amphictyonic League, in which the whole people was represented by tribes (not by states), and the chief functions of which were to guard the interests of the sanctuary of Delphi, and to see that the wars between the separate states of Greece were not too merciless. The fourth bond consisted in the four great national festivals or games, the Olympian, Isthmian, Nemean, and Pythian, on the first of which the whole of Greece based its calendar.

The various separate states of Greece may be divided, according to the form of their constitution, into the two great classes of aristocratic and democratic. Sparta or Laedæmon, the chief town of Laconia and of the Doric tribe, was the leading aristocratic state; and Athens,

the capital of Attica and the chief town of the Ionic tribe, was the leading democratic state; and as a rule all the Doric states, and subsequently all those under the influence of Sparta, resembled that city in their constitution; and all the Ionic states, and those under the influence of Athens, resembled it. These two tribes or races are the only ones that come into prominence during the earlier part of Greek history subsequent to the Doric migration. Sparta is said to have derived its form of government, and all its institutions, in the ninth century B.C., from Lycurgus, whose regulations developed a hardy and warlike spirit among the



people, the results of which were seen in their conquests over surrounding states, especially over the Messenians in the eighth and seventh centuries B.C.

The constitution of Athens appears from the legends of Theseus and Codrus to have been at first monarchical, and afterwards aristocratic, and to have first received a more or less democratic character from Solon at the beginning of the sixth century B.C. This was followed about fifty years later by a monarchical usurpation under Pisistratus, and his sons Hippias and Hipparchus, the last survivor of whom, Hippias, reigned in Athens till 510 B.C. After the expulsion of Hippias the Republic was restored, under the leadership of Cleisthenes, in a more purely democratic form than at first. A brief struggle with the Spartans, whose aid was invoked by some of the nobles, now took place, and Athens emerged from it well prepared for the new danger which threatened Greece.

The Greek colonies in Asia Minor and the adjacent islands, after being conquered by Crœsus, King of Lydia, fell with the fall of Crœsus into the power of Cyrus, King of Persia. In 500 B.C., however, the Ionians revolted with the assistance of the Athenians and Eretrians, and pillaged and burned Sardis. The rebellion was soon crushed by Darius, who destroyed Miletus, and prepared to invade Greece. In 492 he sent an expedition against the Greeks under his son-in-law Mardonius, but the fleet which carried his army was destroyed in a storm off Mount Athos. A second army, under the

had already contended with success against that of the Persians off Artemisium, and had then sailed into the Saronic Gulf, followed by the enemy. Themistocles succeeded in inducing the Persians to attack in the narrow strait between Attica and Salamis, and totally defeated them.

From a neighbouring height Xerxes himself witnessed the destruction of his fleet, and at once began a speedy retreat with his land army through Thessaly, Macedonia, and Thrace, leaving behind him 300,000 men in Thessaly. In the spring of the following year (479) these advanced into Attica and compelled the citizens once more to seek refuge in Salamis; but were so completely defeated at Plataea by the Greeks under Pausanias, that only 40,000 Persians reached the Hellespont. On the same day the remnant of the Persian fleet was defeated by the Greeks off Mount Mycale.

The brilliant part taken by the Athenians under Themistocles in repelling this invasion of Athens greatly increased her influence throughout Greece. From this date begins the period of the leadership or *hegemony* of Athens in Greece, which continued to the close of the Peloponnesian War, 404 B.C. The first thing which Athens exerted her influence to effect was the formation of a confederacy, including the Greek islands and maritime towns, to supply means for the continuance of the war by payments into a



command of Datis and Artaphernes, landed on Eubœa, and after destroying Eretria, crossed the Euripus into Attica; but it was totally defeated in 490 B.C. on the plain of Marathon by 10,000 Athenians and 1000 Platæans, under Miltiades. In the midst of preparations for a third expedition Darius died, leaving his plans to be carried out by his son Xerxes, who, with an army of 1,700,000 men, crossed the Hellespont in 481 by means of two bridges of boats, and marched through Thrace, Macedonia, and Thessaly, while his fleet followed the line of coast. In the pass of Thermopylæ he was held in check by Leonidas with 300 Spartans and 700 Thespians; but the small band was betrayed and annihilated (480 B.C.); and the way through Phocis and Bœotia being now open he advanced into Attica, and laid Athens in ruins. The deliverance of Greece was chiefly due to the genius and courage of Themistocles. The united fleet of the Greeks

common treasury established on the Island of Delos, and by furnishing ships. In this way Athens gradually increased her power so much that she was able to render tributary several of the islands and smaller maritime states. In 469 B.C. the series of victories won by the Athenians over the Persians was crowned by the double victory of Cimon over the Persian fleet and army on the Eurymedon, in Asia Minor, followed by the Peace of Cimon, which secured the independence of all Greek towns and islands. Shortly after followed the brilliant administration of Pericles, during which Athens reached the height of her grandeur.

The position of Athens, however, and the arrogance and severity with which she treated the states that came under her power made her many enemies. In the course of time two hostile confederacies were formed in Greece, one consisting of Athens and the democratic

states of Greece; the other of Sparta and the aristocratic states. At last, in 431, war was declared by Sparta on the complaint of Corinth that Athens had furnished assistance to Corcyra in its war against the mother city; and on that of Megara, that the Megarean ships and merchandise were excluded from all the ports and markets of Attica; and thus began the Peloponnesian War, which for twenty-seven years devastated Greece.

In the first part of the war the Spartans, who invaded Attica in 431 B.C. and three times in the five years following, had considerable successes, which were aided by the pestilence that broke out at Athens and the death of Pericles. In 425, however, Pylos was captured by the Athenian general Demosthenes, and the Spartan garrison on the Island of Sphacteria was compelled to surrender to Cleon. Soon after Cythera fell into the hands of the Athenians, but they were defeated in Boeotia at Delium (424) and at Amphipolis in Thrace by Brasidas in 422, when both Cleon and Brasidas were killed. The Peace of Nicias (421 B.C.), which followed the death of Cleon, brought disaffection into the Spartan Confederacy, the Corinthians endeavouring with Argos and Elis to wrest from Sparta the hegemony of the Peloponnesus. In this design they were supported by Alcibiades; but Sparta was victorious at the battle of Mantinea in 418. Soon after this the Athenians resumed hostilities, fitting out in 415 B.C. a magnificent army and fleet, under the command of Alcibiades, Nicias, and Lamachus, for the reduction of Syracuse. Alcibiades, however, being subsequently deprived of his command on a charge of impiety, betook himself to Sparta, and exhorted the city to renew the war with Athens. By his advice one Spartan army was dispatched to Attica, where it took up such a position as prevented the Athenians from obtaining supplies from Eubœa, while another was sent under Gylippus to assist their kindred in Sicily. These steps were ruinous to Athens. The Athenian army and fleet at Syracuse were completely destroyed, and though the war was maintained with spirit the prestige of Athens was seriously diminished. Many of her allies joined Sparta, and a revolution and brief change of government tended still further to weaken her. Still she made not unsuccessful efforts to regain her position, conquered the revolted towns about the Bosphorus, and defeated the Spartan admiral Callicratidas off the islands of Arginusæ in 406. Sparta, however, was now in receipt of Persian aid, and Lysander, having captured nearly the whole Athenian fleet at Ægospotami (405), retook the towns of Asia Minor, surrounded Athens, and blocked the Piræus. In 404 B.C. the Athenians were starved

into surrender, the fortifications were destroyed, and an aristocratic form of government established by Sparta, placing the supreme power in the hands of thirty individuals, commonly known as the Thirty Tyrants. Only a year later, however (403), Thrasybulus was able to re-establish the democracy.

The period which follows the fall of Athens is that of Sparta's leadership or hegemony in Greece, which lasted till the battle of Leuctra, in 371 B.C. The Spartan rule was not more liked than that of Athens, and the character of the Spartan state itself, with its increase of wealth and power, underwent great change. To escape the stigma of having ceded the cities of Asiatic Greece to Persia, Agesilaus was sent to retake them, but was defeated by the fleet of Pharnabazus under Conon the Athenian; and the states of Greece, the Spartans included, at last, in 387, agreed to the disgraceful Peace of Antalcidas, by which the whole west coast of Asia Minor was ceded to the Persians. An act of violence committed by a Spartan general in garrisoning Thebes in 380 was the commencement of the downfall of Sparta. The Thebans revolted under Pelopidas and Epaminondas, and the Spartans on invading Boeotia were so completely defeated at Leuctra in 371 B.C. that they never fully recovered from the blow. With this victory Thebes won the leading place in Greece, which she maintained during the lifetime of Epaminondas, whose influence was paramount in the Peloponnesus. Epaminondas fell in defeating the Spartans and Arcadians near Mantinea in 362, and his death reduced once more the authority of Thebes in Greece.

Two years after the death of Epaminondas, Philip, the father of Alexander the Great, became King of Macedonia. An occasion for interference in the affairs of Greece was furnished him by the war known as the Sacred War (355–346), arising from the Phocians having taken possession of some of the land belonging to the sanctuary of Delphi. The Thebans besieged the Phocians, and called to their aid Philip of Macedon, who was accorded the place till then held by the Phocians in the Amphictyonic League. It was not, however, till the Locrian War (339–338) that Philip acquired a firm hold in Greece. The Locrians had committed the same offence as the Phocians, and Philip, as one of the members of the league, received the charge of punishing them. The real designs of Philip soon became apparent, and the Athenians, on the advice of Demosthenes, hastily concluded an alliance with the Thebans, and sent an army to oppose him. The battle of Chæronea which ensued (338) turned out, however, disastrously for the allies, and Philip became master of Greece. He then collected an army for the

invasion and conquest of the empire of Persia, and got himself declared commander-in-chief by the Amphictyonic League at Corinth in 337 B.C.; but before he was able to start he was assassinated, 336 B.C.

The design of Philip was taken up and carried out by his son Alexander the Great, during whose absence Antipater was left behind as Governor of Macedonia and Greece. Soon after the departure of Alexander, Agis III of Sparta headed a rising against Antipater, but was defeated at Megalopolis in 330 B.C., and no other attempt was made by the Greeks to recover their liberty for nearly a hundred years. At the close of the wars which followed the death of Alexander, and which resulted in the division of his empire, Greece remained with Macedonia.

The last efforts of the Greeks to recover their independence proceeded from the Achæans, who had for the most part kept aloof from the quarrels of the other states, and did not even furnish assistance to repel the Persian invasion. They had taken part, though reluctantly, in the Peloponnesian War on the side of Sparta, and had shared in the defeat of Megalopolis in 330 B.C. In the course of the first half of the third century B.C. several of the Achæan towns expelled the Macedonians, and revived an ancient confederacy, which was now known as the Achæan League. Aratus of Sicyon became its leading spirit. It was joined also by Corinth, and even by Athens and Ægina. The Spartans, however, who had maintained their independence against Macedonia, naturally looked with jealousy on the efforts of Aratus, and during the reign of Cleomenes a war broke out between Sparta and the Achæan League. The League was at first worsted, and was only finally successful when Aratus sacrificed the ultimate end of the League by calling in the aid of the Macedonians. In the battle of Sellasia (222 B.C.) Cleomenes was defeated, and the Macedonians became masters of Sparta. Aratus died in 213, and his place was taken by Philopœmen, 'the last of the Greeks', who succeeded in making the League in some degree independent of Macedonia.

About this time the Romans, who had just come out victorious from a second war with Carthage, found occasion to interfere in the affairs of Greece. Philip V of Macedon having allied himself with Hannibal, the Romans sent over Flamininus to punish him, and in this war with Philip the Romans were joined by the Achæan League. Philip was defeated at Cynoscephalæ in 197 B.C., and was obliged to recognize the independence of Greece. The Achæan League thus became supreme in Greece, having been joined by all the states of the Peloponnesus.

But the League itself was in reality subject to Rome, which found constant ground for interference until 147 B.C., when the League openly resisted the demand of the Senate, that Sparta, Corinth, Argos, and other cities should be separated from it. In the war which ensued, which was concluded in 146 B.C. by the capture of Corinth by the Roman consul Mummius, Greece completely lost its independence, and was subsequently formed into a Roman province.

On the division of the Roman Empire Greece fell of course to the eastern or Byzantine half. From 1204 to 1261 it formed a part of the Latin Empire of the East, and was divided into a number of feudal principalities. In the latter year it was reannexed to the Byzantine Empire, with which it remained till it was conquered by the Turks between 1460 and 1473. In 1609 the Morea was ceded to the Venetians, but was recovered by the Turks in 1715. From 1715 till 1821 the Greeks were without intermission subject to the domination of the Turks. In 1770, and again in 1790, they made vain attempts at insurrection, but in 1821 Ali, the pasha of Janina, revolted against the Sultan Mahmoud II, and secured the aid of the Greeks by promising them their independence. The rising of the Greeks took place on the 6th of March, under Alexander Ypsilanti, and on the 1st of Jan., 1822, they published a declaration of independence. In the same year Ali was assassinated by the Turks, but the Greeks, encouraged by most of the European nations, continued the struggle under various leaders, of whom the chief were Marcos Bozzaris, Capo d'Istria, Constantine Kanaris, Kolocotroni, &c. In 1825 the Turks, with the aid of Ibrahim Pasha, took Tripolitza, the capital of the Morea, and Missolonghi, and though Lord Cochrane organized the Greek fleet, and the French colonel Fabvier their army, the Turks continued to triumph everywhere. A treaty was then concluded at London (6th July, 1827) between Britain, France, and Russia for the pacification of Greece, and when the mediation of these three powers was declined by the Sultan, their united fleets, under Admiral Codrington, annihilated the Turkish fleet off Navarino, 20th Oct., 1827. In the beginning of the following year (1828) Count Capo d'Istria became President of the state, and later on in the same year Ibrahim Pasha was forced to evacuate Greece. At last, on the 3rd of Jan., 1830, a protocol of the allied powers declared the independence of Greece, which was recognized by the Porte on the 25th April of that year. The crown was offered to Leopold, Prince of Saxe-Coburg, and when he refused it, to Otto, a young prince of Bavaria, who was proclaimed King of the Hellenes at Nauplia in 1832. But his arbitrary measures, and the preponderance

which he gave to Germans in the government, made him unpopular, and although after a rebellion in 1843 a Constitution was drawn up, he was compelled by another rebellion in 1862 to abdicate. A Provisional Government was then set up at Athens, and the National Assembly offered the vacant throne in succession to Prince Alfred of England and Prince William George of Denmark. The latter accepted it, and on 30th March, 1863, was proclaimed as King George I. In 1864 the Ionian Islands, which had hitherto formed an independent republic under the protection of Britain, were annexed to Greece.

From the first Greece has sought an opportunity of extending its frontier northwards, so as to include the large Greek population in Thessaly and Epirus. In Jan., 1878, after the fall of Plevna, Greek troops were moved into Thessaly and Epirus, but were withdrawn on the remonstrance of Britain. The promises held out to Greece by the Berlin Congress were in danger of being withdrawn, but the persistence of Greece led in 1881 to the cession to her of Thessaly and part of Epirus. The union of Eastern Roumelia with Bulgaria, in 1885, gave rise to fresh demands, and war with Turkey was only prevented by the Great Powers. In 1897 an insurrection in Crete led to the interference of the Greeks and to war with Turkey, the result being the speedy defeat of Greece, entailing the payment of a heavy war indemnity with some loss of territory on the Thessalian frontier. The European powers, however, compelled Turkey to withdraw her troops from Crete, which was thus liberated, and became an autonomous island (see *Crete*). In 1912 the Balkan War broke out, Greece joining Serbia and Bulgaria against Turkey. The result of this war was an acquisition of new territories by Greece. In March, 1913, King George was assassinated at Salonica, and was succeeded by his son Constantine. During the European War Greece, at first neutral, ultimately was prevailed upon by Venizelos to join the Allies. King Constantine was compelled to abdicate, being succeeded by his son Alexander, who died in Oct., 1920. Venizelos was defeated at the next election and Constantine was recalled, only to abdicate (1922) in favour of his son Georgios II. He was forced to leave the country in 1923 and a republic was established in 1924. (See *Constitution* above.)—BIBLIOGRAPHY: Sir C. W. Oman, *History of Greece*; G. Grote, *History of Greece*; J. B. Bury, *History of Greece to the Death of Alexander the Great*; *Cambridge Modern History*; L. M. Garnett, *Greece of the Hellenes*; P. F. Martin, *Greece of the Twentieth Century*; Sir J. P. Mahaffy, *Social Life in Greece*.

Religion of Ancient Greece.—The religion of

the ancient Greeks was polytheism, there being a great number of divinities, many of whom must be regarded as personifications of natural powers, or of phenomena of the external world, or personified sentiments. Thus there were gods corresponding to Earth and Heaven, the Ocean and Night. The Romans, when they became acquainted with the literature and religion of the Greeks, identified the Greek deities with those of their own pantheon. In this way the Greek and Roman deities came to be confounded together, and the names of the latter even came to supersede those of the former. The supreme ruler among the gods was Zeus (Roman Jupiter or Juppiter), the son of Kronos (Roman Saturn), who after the subjugation of the Titans and Giants ruled in Olympus, while his brother Pluto reigned over the lower world (Hades, Tartarus), and Poseidōn (Neptune) ruled in the sea. Like reverence was paid to Hēra (Juno), the sister and wife of Zeus, and the queen of Heaven; to the virgin Pallas Athēnē (Minerva); to the two children of Lētō (Latona), namely, Apollo, the leader of the Muses, and his sister the huntress Artēmis (Diana), the goddess of the moon; to the beautiful daughter of Zeus, Aphrodītē (Venus), the goddess of love; to Arēs (Mars), the god of war, Hērmeēs (Mercury), the herald of the gods, and others besides. In addition to these there was an innumerable host of inferior deities (Nymphs, Nereids, Tritons, Sirens, Dryads and Hamadryads, &c.) who presided over woods and mountains, fields and meadows, rivers and lakes. There was also a race of heroes or demigods (such as Heracles or Hercules and Perseus) tracing their origin from Zeus, and forming a connecting link between gods and men, while on the other hand the Satyrs formed a connecting link between the race of men and the lower animals.

Religious teachers were not a distinct class in Greece. The priests were in no sense preachers of doctrines, but merely hierophants, or exhibitors of sacred things, of rites, symbols, and images. They showed how a god was to be worshipped; but it was not their office to teach theological doctrine, or even as a rule to exhort to religious duty. The true teachers of the Greek religion were the poets and other writers, and it is to the hymns, epics, dramas, and histories of the Greeks that we must turn in order to learn how they regarded the gods. No degree of consistency is to be found in them, however, the personality and local origin of the writers largely moulding their views. A belief in the justice of the gods as manifested in the punishment of all offences against them was cardinal. The man himself might escape, but his children would suffer, or he might be

punished in a future state—the latter view being less commonly held than the former of an entailed curse. The gods are also represented by the Greeks as holy and truthful, although they are in innumerable other passages described as themselves guilty of the grossest vices, and likewise as prompting men to sin, and deceiving them to their own destruction. In their general attitude towards men the gods appear as inspired by a feeling of envy or jealousy. Hence they had constantly to be appeased, and their favour won by sacrifices and offerings. Certain classes were, however, under the peculiar protection and favour of the gods, especially strangers and suppliants. The Greeks believed that the gods communicated their will to men in various ways, but above all by means of oracles, the chief of which were that of Apollo at Delphi, and that of Zeus at Dodona. Dreams ranked next in importance to oracles, and divination by birds, remarkable natural phenomena, sneezing, &c., was practised. The Greeks appear to have had at all times some belief in a future existence, but in the earliest times this belief was far from being clearly defined.—BIBLIOGRAPHY: Sir James G. Frazer, *The Golden Bough*; L. R. Farnell, *Cults of the Greek States*; L. Campbell, *Religion in Greek Literature*; J. E. Harrison, *Prolegomena to the Study of Greek Religion*; A. Fairbanks, *A Handbook of Greek Religion*; J. Adam, *The Religious Teachers of Greece*; G. Murray, *Four Stages of Greek Religion*.

Greek Language.—The Greek language belongs to the Indo-European group, and is thus a sister of the Sanskrit, Latin, Teutonic, and Celtic tongues. It is customary to distinguish three leading dialects according to the three leading branches of the Greeks, the Æolic, the Doric, and the Ionic, to which was afterwards added the mixed Attic dialect; besides these there are several secondary dialects. Akin to the Ionic is the so-called Epic dialect, that in which the poems of Homer and Hesiod are written, and which was afterwards adopted by other Epic writers. The Doric was hard and harsh; the Ionic was the softest. The Æolic was spoken on the north of the Isthmus of Corinth (except in Megara, Attica, and Doris), in the Æolian colonies of Asia Minor, and on some of the northern islands of the Ægean Sea. The Doric was spoken in the Peloponnesus, in Doris, in the Doric colonies of Asia Minor, of Lower Italy (Tarentum), of Sicily (Syracuse, Agriguntum); the Ionic in the Ionian colonies of Asia Minor, and on the islands of the Archipelago; and the Attic in Attica. In each of these dialects there are celebrated authors. The Ionian dialect is found pure in Herodotus and Hippocrates. The Doric is used in the poems of Pindar, Theocritus, Bion, and Moschus. In

Æolic we have fragments of Alcæus and Sappho. After Athens had obtained the supremacy of Greece, and rendered itself the centre of all literary cultivation, the masterpieces of Æschylus, Sophocles, Euripides, Aristophanes, Thucydides, Xenophon, Plato, Aristotle, Isocrates, Demosthenes, &c., made the Attic the common dialect of literature. Grammarians afterwards distinguished the genuine Attic, as it exists in those masters, from the Attic of common life, calling the latter the *common Greek* or *Hellenic* dialect. In this latter dialect wrote Theophrastus, Apollodorus, Polybius, Plutarch, and others. Many later writers, however, wrote genuine Attic, as Lucian, Ælian, and Arrian. Except the dramatists, the poets by no means confined themselves to the Attic; the dramatists themselves assumed the Doric, to a certain degree, in their choruses, and the other poets retained the Homeric style, which was a congeries of forms occurring as peculiarities in the various dialects.

At what time this language first began to be expressed in writing has long been a subject of doubt. According to the usual account, Cadmus the Phœnician introduced the alphabet into Greece; and it is an undoubted fact that the most of the Greek letters are derived from the Phœnician ones. The Greek alphabet possesses the following twenty-four letters:—Α, α (alpha), a; Β, β (beta), b; Γ, γ (gamma), g; Δ, δ (delta), d; Ε, ε (epsilon), é; Ζ, ζ (zeta), z; Η, η (eta), ê; Θ, θ, ϑ (theta), th; Ι, ι (iota), i; Κ, κ (kappa), k; Λ, λ (lambda), l; Μ, μ (mu), m; Ν, ν (nu), n; Ξ, ξ (xi), x; Ο, ο (omicron), i.e. small o, ô; Π, π (pi), p; Ρ, ρ (rho), r; Σ, σ, ς (sigma), s; Τ, τ (tau), t; Υ, υ (upsilon), u, commonly transliterated by y; Φ, φ (phi), ph; Χ, χ (chi), ch guttural (as in Scottish *loch*); Ψ, ψ (psi), ps; Ω, ω (omega, or great o), ô. The alphabet originally introduced into Greece is said to have consisted of but sixteen letters, Θ Ξ Φ Χ Ζ Η Ψ Ω being of later introduction.

Modern Greek, as spoken by the uneducated classes, is called *Romaic*, from the fact that those who speak it considered themselves before the descent of the Turks upon Europe as belonging to the Roman Empire, and hence called themselves *Romaioi*, or Romans. The Greek of the educated classes, that used in the newspapers and other literature of the present day, is distinguished from it by a greater resemblance to the Greek of antiquity, which renders it easy for anyone who has a satisfactory acquaintance with ancient Greek to read the modern literary Greek. Besides the foreign words introduced into modern Greek, many words have changed their original signification. The grammar has also undergone considerable modification. For example, the numbers have been reduced to

two by the suppression of the dual; and the cases to four by the disappearance of the dative, which is now expressed by a preposition with the accusative. The first cardinal numeral is now used as an indefinite article. The degrees of comparison are sometimes expressed by the use of *pleon* (more). The past and future tenses are formed by the aid of the verbs *echō* (I have), and *thelō* (I will). The infinitive mood has its place supplied by a periphrasis with the verb in the subjunctive, and the middle voice has disappeared. The ancient orthography is still preserved, but the vowels *η*, *ι*, and *υ*, and the diphthongs *ει*, *οι*, *υι*, are all pronounced like *ee* in English *seen*; *β* is now pronounced as *v*, and the sound of *β* is expressed by *μν*; *Δ* is pronounced like *th* in *thus*, and *θ* like *th* in *think*. —BIBLIOGRAPHY: J. Wright, *Comparative Grammar of the Greek Language*; A. T. Robertson, *A Grammar of New Testament Greek in the Light of Historical Research*; A. Thumb, *Handbuch der neugriechischen Volkssprache*.

Greek Literature.—The commencement of extant Greek literature is to be found in the two epic poems attributed to Homer, the *Iliad* and the *Odyssey*, which it is commonly believed took shape on the Ionian coast or its islands somewhere between 950 and 850 B.C., and came thence to Greece proper (see *Homer*). The former deals directly with the Trojan War; the latter describes the wanderings of Ulysses in returning from it. Another poem, the *Batrachomyomachia* (Battle of the Frogs and Mice), a burlesque epic which is not remarkably entertaining, was originally attributed to Homer as a joke, and the joke was taken seriously by many generations of scholars. It was actually written by an unknown humorist of the time of Alexander the Great. In European Greece there appeared about the middle of the ninth century, at Ascrea in Boeotia, the poet Hesiod, who stood at the head of another epic school. Of the sixteen works attributed to him there have come down to us the *Theogony* (Origin of the Gods), the *Shield of Heracles* (a fragment of a larger poem of later authorship), and, most important of all, the *Works and Days*, a didactic work on agriculture. The works of Homer and Hesiod were the principal schoolbooks in Greece, Homer in particular taking in Greek education the place once taken in English education by the Bible. The Homeric and Hesiodic schools begin to meet in the Homeric hymns composed by different hands between 750 and 500 B.C. Next came the period of Elegiac and Iambic poetry (700–480), both Ionian, in which the poet's own feelings and personality became distinctly manifested, the chief names being those of Callinus of Ephesus (flourished about 690 B.C.), Tyrtaeus, originally of Attica (675), Archilochus of Paros (670),

Simonides of Amorgos (660), Mimnermus of Smyrna (620), Solon of Athens (594), Theognis of Megara (540), Phocylides of Miletus (540), Xenophanes of Colophon (510), Hipponax of Ephesus (540), Simonides of Ceos (480). Greek lyric poetry was inseparably linked with music, the lyric period proper lasting from about 670 to 440 B.C. Two principal schools may be distinguished, the Æolian and the Dorian. To the former belong Alcæus (611–580), Sappho (610), and Anacreon (530), though the series of erotic poems long attributed to Anacreon is really Alexandrian. To the Dorian school belong Aleman of Sparta (660 B.C.), credited with the invention of the strophe and antistrophe; Stesichorus (Tisias) of Himera (620), who added to these the epode; Arion (600), who gave shape to the dithyramb; and Ibycus of Rhegium (540). Simonides of Ceos (480) was even more famous as lyric poet than as elegist, his lyrics marking the commencement of a school of national lyric poetry. His nephew, Bacchylides, was also famous, but the chief was undoubtedly Pindar (522–443). About this time began a new literary development, that of the drama, the earliest names in which are Thespis (536) and Phrynichus (512–476). The performance at first, however, was merely a sort of oratorio or choral entertainment, until Æschylus (525–456) introduced a second actor, and interspersed choral song with dialogue. The tragedies of Æschylus are unsurpassed, and if equalled are equalled by Shakespeare alone. A third and (according to some authorities) even a fourth actor was added by Sophocles (495–405) B.C., who supplemented the heroic tragedy of Æschylus with the tragedy of human character and the fundamental passions. Euripides (480–406) brought new qualities of picturesqueness, homeliness, realism, and pathos with a less rigid artistic method, and formed a fitting third in the great tragic triad. With this rapid growth of tragedy there was a corresponding development of comedy, which assumed an artistic form about 470 B.C. The names of Cratinus (448) and Eupolis (430) are overshadowed by that of Aristophanes (448–385), who for nearly forty years was the burlesque commentator upon the life of the period. His work, which alone has survived, but which probably follows the law of the survival of the fittest, may be regarded as closing the period of the old comedy; the middle comedy of from 390 to 320 (Antiphanes, Alexis, and others) was transitional from the great political comedy to the new comedy of manners, which was vigorous from 320 to 250 in the hands of Menander, Philemon, and Diphilus.

In the meantime a prose literature had arisen, commencing with the group of early Ionian

writers (550–450), of which Pherecydes of Syros, Anaximenes, and Anaximander, philosophers, and the logographer or compiler Hecataeus of Miletus were chief. Hellanicus of Mitylene (450) was one of the earliest critical historians, but Herodotus (484–428) was the first writer of great historic rank, as he was also the first great prose stylist. Thucydides (471–400?) was the founder of philosophic history, and Xenophon (431–354), who has left excellent historic narratives, was also the earliest Greek essayist. The oldest piece of Attic prose is the essay on Athenian polity wrongly assigned to Xenophon. Other writers in history were Ctesias (415–398), Philistus (363), Theopompus (352), and Ephorus (340). From 360 onwards Attic history and archaeology were preserved in works by various writers, of whom Philochorus (306–260) was chief. The study which oratory and rhetoric received in Athens was an important factor in shaping Attic prose, the chief orators being Antiphon (480–411), Andocides (415–390), Lysias (403–381), Isocrates (436–338), Isæus (390–353), and, above all, Demosthenes (384–322) with his contemporaries Æschines, Lycurgus, and others, and Demetrius of Phalerum (318), the last of whom marks the beginning of decay in the art. Philosophy shared the development of history and oratory, reaching a rare elevation in Plato (429–347), a rare comprehensiveness in Aristotle (384–322), the founders of the academic and peripatetic schools. Minor Socratic schools were the Cyrenaic, founded by Aristippus (370), the Megaric, founded by Euclid (399), and the Cynic, founded by Antisthenes. In the earlier part of the third century the rival schools of Epicurus (342–270) and of Zeno (344–260) became prominent.

From about the year 300 B.C. the literary decadence may be held to date; the period 300 to 146 being known as the Alexandrian. It comprises the learned poetry of Callimachus (who flourished at Alexandria 250 B.C.) and of Lycophron (260); the epic of Apollonius Rhodius (194); the didactic poetry of Aratus (270) and Nicander (150); the pastoral poetry of Theocritus, Bion, and Moschus; the satirical Silloi of Timon (280); the philology and criticism of Zenodotus (280), Aristophanes of Byzantium (200), Aristarchus (156), and Apollodorus (140); the version of the *Septuagint*; and the scientific works of Euclides (300), Archimedes and Eratosthenes (240). From 146 B.C. dates the Græco-Roman period in Greek literature, to which belong the historians Polybius (145 B.C.), Diodorus Siculus (40 B.C.), Dionysius of Halicarnassus (25 B.C.), Josephus, Arrian (A.D. 100), Appian (A.D. 140), and Herodian (A.D. 240); the biographies of Plutarch (A.D. 90), of Diogenes Laertius and of Flavius Philostratus (A.D. 235);

the geographies of Strabo (A.D. 18) and of Pausanias (A.D. 160); the astronomy and geography of Ptolemy; the informatory works of Athenæus (190), Ælian (220), and Stobæus (480); the rhetorical and literary works of Hermogenes (170), Aphthonius and Cassius Longinus (260); the medical works of Galen (160); the satirical works of Lucian (160) and of Julian (331–363); and the development of the Greek romance, best represented in Heliodorus (390), Achilles Tatius, and Chariton. During this period philosophy is in the main divided between Stoicism and Neoplatonism, the former represented by Epictetus (A.D. 90) and Marcus Aurelius (170), the latter by Plotinus (240), Porphyry, and Iamblichus. The school of Athens had for chief exponent the eclectic Proclus (450). In verse the best names were the fabulist Babrius (40), Oppian (180), Nonnus, Quintus Smyrnaeus (400–450), and Musæus (500). The special feature of the later Græco-Roman period was the rise of a Christian Greek literature represented by the patristic epistles, homilies, &c., and ecclesiastical histories, such as those of Eusebius, Socrates, and Sozomen. Among the chief writers were Justin Martyr, Origen, and Clement of Alexandria, Eusebius, Gregory of Nazianzus, Basil, Gregory of Nyssa, and Chrysostom. After 529 and until 1453 came the Byzantine period, of which the most important section was from about 850 to 1200. It was characterized by such writers as Eustathius, Photius, and Suidas, mainly occupied in the attempt to reduce to system a large, ill-ordered, and aimless erudition.

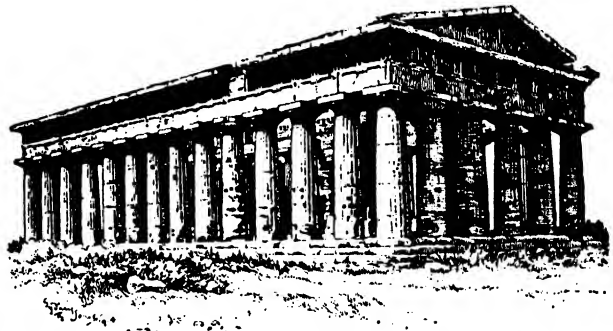
On the fall of Constantinople in 1453 the cultivated classes who still retained the pure Greek either perished or took to flight, or adopted the language of the conquerors. The popular Greek, however, survived, and despite its vulgarization and the modification of its grammatical forms and syntax, it cannot be said that Greek has been a dead language at any period since Homer. By some, modern Greek literature is dated from Theodore Prodromos (1143–80), a monk and writer of popular verse, but the only names of importance until the close of the eighteenth century are those of Maximus Margunius (1530–87), Anacreontic poet and letter writer; Leo Allatius (1586–1669), Sciote scholar and poet; George Chortakes (seventeenth century), Cretan poet; Francisus Scuphos, Cretan writer on rhetoric (1681); Elias Meniates (1669–1714), a Cephalonian ecclesiastic; Vincentius Kornaros, Cretan poet, author of *Erotocritos* (1756); Kosmas, the Ætolian (1714–79), preacher and founder of schools; Rhegas Pherraios (latter half of eighteenth century), patriotic poet; Eugenios Bulgaris (1716–1806), writer of scientific and religious works; and Nicephorus Theotokes (1736–1800), writer on metaphysics and

theology. At this period the patriotic movement found one outlet in the purification of the language and the development of a new literary impulse. The most important figure was that of Adamantios Korais or Coray (1748–1833), who did more than all his predecessors to found a literature. Anthimos Gazes (1704–1837) and Athanasios Christopoulos (1772–1847) were eminent as grammarians and lexicographers, the latter also as a lyric poet. Neophytus Bambas (1770–1855), miscellaneous educational writer; Constantine Aëconomos (1780–1857), theological writer; Theoclytus Pharmakides (1784–1862), ecclesiastic and journalist; Spiridion Zampelios, literary antiquary; and Trikoupis, orator of the struggle for independence, were also prominent. The poetry of the people is represented chiefly in the songs of the Klephts and other songs dating from the war of independence. At this period the war-songs of Rhigas were sung by the whole nation, and at a later period the two Soutsos, Panagios and Alexander, Calvos, Dionysios Salomos (1798–1857), Julius Typaldos of Cephalonia (1814–83), Aristoteles Valaorites (1824–79), George Zalakostas (1805–58), and others, earned distinction in the same kind of poetry. The Soutsos were further distinguished as satirists, and Alexander Soutsos ranks also with the dramatists Rhisos, Neroulos, and Zampelios. Among the most gifted of later writers are Rhisos Rangabé (1810–92), distinguished in lyric, dramatic, and epic poetry, also as a novelist and a scholar; Dimitrios Bikelas, George Soares, Angelos Vlachos, and others.—BIBLIOGRAPHY: G. Murray, *History of Ancient Greek Literature*; W. C. Wright, *A Short History of Greek Literature*; Sir J. P. Mahaffy, *History of Classical Greek Literature*; J. A. Symonds, *Studies of the Greek Poets*; R. W. Livingstone, *The Greek Genius and its Meaning to Us*; L. M. J. Garnett, *Greek Folksongs from the Turkish Provinces of Greece*.

Ancient Greek Art.—As in literature so in art the Greeks attained the highest pitch of excellence, and in architecture and sculpture furnished models for the rest of the world. In no other race has the artistic spirit been so generally diffused throughout the people, expressing itself in the minor arts of life, in the practical application of ornament in the forms of domestic furniture, pottery, metalwork, mosaics, and the like, not less perfectly than in the master-works of architecture and sculpture.

The earliest architectural remains in Greece are pre-Hellenic in origin and Asiatic in char-

acter, Greek architecture proper dating from about the close of the eighth century B.C. The earliest known example—the Doric temple at Corinth—belongs to about the middle of the seventh century B.C., and points to an Egyptian origin, the style being remotely derived from the so-called 'proto-Doric' temple of Beni Hassan in Lower Egypt. Throughout the history of the art it is the public buildings, more particularly the temples, in which the genius of the Greeks displayed itself. The private houses remained simple and unfinished in appearance, rarely rising above a single story, and having no external decoration. The temples were for the most part rectangular, though the circular form sometimes occurs in the later periods of



Greek Architecture (Doric order). The Temple of Poseidon, Paestum

Greek art. In the simplest form of the rectangular temple (the *aptemal*) there were no columns; but, by an easy development from this, the side walls were carried out beyond those constituting the ends of the building, so as to form a porch. The extended walls terminated in pilasters (*antæ*) between which, in the front line of the porch, two columns were placed. As a further development, four additional columns were placed in advance of the line connecting the *antæ*, sometimes in front only (*prostyle*), sometimes at both ends (*amphiprostyle*). More complex forms were known as *peripteral*, where the columns were carried completely round the building; as *dipteral*, where a double range of columns surrounded it; and as *pseudo-dipteral*, where a double range of columns was placed in front and rear, but only a single range at the sides. The dipteral and pseudo-dipteral styles were seldom employed, the chief example of the dipteral having been the temple of Diana at Ephesus, built by Ctesiphon in the sixth century B.C. Most of the famous temples in Greece were, however, *peripteral*. Three orders are distinguished in Greek architecture, according to the treatment

of the pillars and of the entablature—the Doric, Ionic, and Corinthian (q.v.). Of these the Doric is the most ancient, the most important examples in Greece, besides that already mentioned, being the temple at *Ægina* (middle of the sixth century B.C.), the temple of Theseus at Athens, and the Parthenon, constructed about 448 B.C. by the architects Ictinus and Callicrates, and adorned with unsurpassed sculpture by Phidias and his pupils. Next to these came the temple of Zeus at Olympia, the temple of Apollo at Bassæ, the frieze of which is in the British Museum, the temple of Athênê at Sunium, the great temple at Rhamnus, and those at Selinus

total effect, the old tufa temples being coloured throughout, and even in the marble temples, though it is doubtful if the marble columns were ever coloured, the mouldings of cornices and ceilings, the capitals of the antæ, the mouldings of the pediment and the triglyphs were all decorated with colour. The colonnades and porticoes, which were usually built round market-places and along quays in seaport towns, were similar in style to the temples. See *Architecture*.

Greek sculpture has been divided into five principal periods, namely: (1) the Dædalian or Early (–580 B.C.); (2) the Æginetan or Archaic (580–480 B.C.); (3) the Phidian or Grand (480–400 B.C.); (4) the Praxitelean or Beautiful (400–250 B.C.); (5) the Decline (250 B.C. onwards). The age of Dædalus marks an advance from an earlier primitive sculpture in which blocks of wood and stone were roughly fashioned into the semblance of life, the imperfections of the art being concealed by real hair and adventitious draperies. During the Dædalian period the treatment was highly conventionalized, a single type serving for a variety of divinities and heroes, the hair being often entirely curled and gathered into a club behind, and the dresses of the female divinities being divided into a few perpendicular folds. Many



Greek Architecture (Ionic order). The Erechtheum, Athens

in Sicily (middle of seventh century), Agrigentum, Segesta, and Paestum. The oldest Ionic temple in Greece was probably the temple of Ilissus (about 488 B.C.), but the oldest of which remains are still visible is that dedicated to Juno at Samos, and there are remains of a fine temple of this order at Teos. The most perfect example, however, is the Erechtheum at Athens. The Corinthian order, though Grecian in its origin, is represented amongst the Greek temples by a single example only, that of the Zeus Olympius at Athens; and even this temple belongs to the Roman period. The Choragic monument of Lysicrates at Athens also belongs to this order. The beauty of the Greek buildings was heightened in respect of form by a deviation from ordinary rectilinear construction, in the systematic substitution of delicately-curved lines for straight lines in the columns and steps of their temples, and wherever the illusion attending the sight of straight lines in perspective was likely to prove an element of weakness. Colour and gilding also played an important part in the

of these characteristics survived in the Æginetan period, but a higher knowledge of anatomy and greater freedom and boldness of treatment are apparent. The sculptures of the Theseum form a connecting link between the Æginetan school and that of Phidias. To Phidias, besides his statues of Athena and Zeus, were due the designs for the sculptures of the Parthenon, the actual work of these, however, being probably done by his pupils Alcamenes, Agoracritus, and other artists of his time. To this age belonged the sculptor and architect Polycleitus (about 452–412 B.C.), whose statue of a youth holding a spear obtained the name of *The Canon*, as being a standard of form. About the same time the Boeotian sculptor Myron flourished, the famous *Discobolus* being a reproduction in marble of one of his bronzes. The Praxitelean period is characterized by greater grace and elegance in choice of subject and treatment, together with more of the sensual element making for ultimate decline. Praxiteles excelled in female figures, his *Aphrodite* at Cnidus in Caria being his most famous work.

His rival, Scopas of Paros, was employed on the bas-reliefs of the Mausoleum at Halicarnassus, and was the sculptor of the famous group representing the destruction of the children of Niobe. In Lysippus of Sicyon, in the time of Alexander the Great, the Praxitelean school found its last great figure prior to the decline of the art.

Painting in Greece is said to have had its origin in Sicyon, and to have existed as mere outline and monochrome until Cimon of Cleonæ introduced variety in colouring, foreshortening, and a less rigid art. The Greek artists worked in wax or resin or in water-colour, brought to the required consistency by mixing with gum, glue, or white of egg; and they painted upon wood, clay, plaster, stone, parchment, and canvas. Until a late period, however, they rarely painted upon walls, usually painting upon panels or tablets to be encased in walls. The earlier masters appear to have used only four colours—red, yellow, white, and black—but by the time of Apelles and Protogenes many other pigments were in use. The earliest painters of renown were Micon of Athens (about 460 B.C.), and Polygnotus of Thasos and of Athens (about 463–430 B.C.); but a higher degree of illusion and realism appears to have been reached under Zeuxis and his rival Parrhasius, towards the close of the fifth century B.C. A greater name than any of these is that of Apelles, the friend of Alexander the Great, contemporaneously with whom flourished Protogenes of Caria, painter and statuary, and Nicias of Athens, a distinguished encaustic painter. Of the work of these artists only a general conception can be formed from the mosaics and frescoes of Pompeii. —BIBLIOGRAPHY: E. A. Gardner, *Handbook of Greek Sculpture*; P. Gardner, *The Principles of Greek Art*; Perrot et Chipiez, *Histoire de l'art dans l'antiquité*; A. P. Laurie, *Greek and Roman Methods of Painting*; H. B. Walters, *The Art of the Greeks*.

Greek Church, or Holy Oriental Orthodox Apostolic Church, that section of the Christian Church dominant in Eastern Europe and Western Asia, especially in Turkey, Greece, Russia, and some parts of Austria. In the first ages of Christianity numerous Churches were founded by the Apostles and their successors in Greek-speaking countries: in Greece itself, in Syria, Egypt, Mesopotamia, Asia Minor, Thrace, and Macedonia. These were subsequently called Greek, in contradistinction to the Churches in which the Latin tongue prevailed. The removal of the seat of empire by Constantine to Constantinople, and the subsequent separation of the Eastern and Western Empires, afforded the opportunity for diversities of language, modes of thinking, and

customs to manifest themselves, and added political causes to the grounds of separation. During the earliest period the chief seats of influence in the Eastern Church were Jerusalem, Antioch, and Alexandria, the seat of that mystical philosophy by which the Oriental Church was distinguished. In 341, soon after the Synod of Antioch, the rivalry between the Bishop of Rome and the Bishop of Constantinople began to assume importance, and before 400, differences of doctrines with respect to the procession of the Holy Spirit appeared. The Council of Chalcedon in 451 accorded to the eastern bishop the same honours and privileges in his own diocese as those of the Bishop of Rome, and in 484 each bishop excommunicated the other. The title of *Œcumenical Patriarch* was assumed by John, Bishop of Constantinople, in 588, and in the following year the phrase *Filioque* ('and the Son') was added by the Latins to the Nicene creed (which now read "proceeding from the Father and the Son"), an addition to which the Greek Church was opposed. In 648 Pope Theodore deposed Patriarch Paul II; but a reconciliation of the Churches was effected at the Council of Rome (680). The doctrines of the Greek Church were defined by John Damascenus in 730. The disruption was hastened by the banishment of Ignatius by Michael the Drunken and the consecration of Photius (858). The Pope Nicholas I and Photius excommunicated each other in 867. The schism was temporarily healed after the death of Photius, but Michael Cerularius reopened it by charging the Latins with heterodoxy. He was excommunicated by Leo IX in 1054, and in turn excommunicated the Pope in the same year, since which the Greeks have been severed from the Roman communion, though the Russo-Greek Church was not separated until the twelfth century. The presence of the Crusaders in the East aggravated the quarrel; Latin patriarchates were established in Antioch and Jerusalem, and, though on the capture of Constantinople by the Crusaders a Latin patriarchate was set up there (1204), the schism was revived there as soon as the Latin Empire fell (1262). Reunion was proposed in 1273 by Patriarch Joseph, and effected, with the acknowledgment of the Pope as primate, at the Council of Lyons (1274). The union, however, was annulled in 1282 by Emperor Andronicus II, and in 1283 and 1285 by Synods of Constantinople. It was again effected under John Palæologus at Florence in 1439, but was repudiated in 1443 by the Patriarchs of Alexandria, Antioch, and Jerusalem. In 1453, when the patriarch fled from the Turks, a schismatic, Gregory Scholaris, was chosen in his place. In 1575 unsuccessful negotiations were commenced with a view to

union with the Lutherans, and in 1723 the English bishops even proposed that the Greek and Anglican Churches should unite, a proposal revived by the Archbishop of Moscow in 1866. The claims of the Tsar in 1853 to the protectorate of the Greek churches in Turkey was one of the causes of the Crimean War.

The Greek Church is the only Church which holds that the Holy Ghost proceeds from the Father only; the Roman Catholic and Protestant Churches deriving the Holy Ghost from the Father and the Son. Like the Roman Catholic Church it has seven sacraments: Baptism, Communion, Confirmation, Penance, Orders, Matrimony, and Unction. But it is peculiar (1) in believing in baptism by threefold immersion, the chrism (confirmation) following immediately after it; (2) in adopting, as to the eucharist, the doctrine of the real presence and transubstantiation; but in ordering the bread to be leavened, the wine to be mixed with water, and both elements to be distributed to every one, even to children; (3) the parochial clergy are required to be married, but only once and to a virgin, and marriage must take place before ordination; widowed clergy are not permitted to retain their livings, but go into a cloister, where they are called *hieromonachi*. The Greek Church grants divorce in case of proved adultery, but it does not allow even the laity a fourth marriage. It differs also from the Roman Catholic Church in anointing with the holy oil, not the dying but the sick, for the restoration of health, forgiveness, and sanctification. It rejects the doctrine of purgatory, works of supererogation, indulgences, and dispensations, but admits prayers for the dead, whose condition appears to be considered undetermined until the final judgment. It recognizes no visible vicar of Christ on earth, but the spiritual authority of the patriarch is little inferior to that of the Pope. It allows no carved, sculptured, or molten image of holy persons or subjects; but the representations of Christ (except in the crucifix), of Mary, and the saints, must be merely painted, and at most inlaid with precious stones. In the Russian churches, however, works of sculpture are found. In the invocation of the saints, and especially of the Virgin, the Greeks resemble the Latins. They also hold relics, graves, and crosses sacred; and crossing in the name of Jesus they consider as having a wonderful and blessed influence. Among the means of penance, fasts are particularly numerous with them. They fast Wednesday and Friday of every week, and besides observe four great annual fasts, namely, forty days before Easter; from Whitsuntide to the days of St. Peter and Paul; the fast of the Virgin Mary, from the 1st to the 15th of Aug.; and the apostle Philip's fast, from the 15th to the 26th of Nov.;

besides the day of the beheading of John the Baptist, and of the elevation of the cross. The calendar of the Greek Church is in the old style, their New Year's Day falling on 14th Jan.

The services of the Greek Church consist almost entirely in outward forms. Preaching and catechizing constitute the least part of it. Instrumental music is excluded altogether. The Mass is considered of the first importance. The convents conform, for the most part, to the strict rule of St. Basil. The Greek abbot is termed *higumenos*, the abbess *higumenē*. The abbot of a Greek convent which has several others under its inspection is termed *archimandrite*, and ranks next a bishop. The lower clergy in the Greek Church consist of readers, singers, deacons, &c., and of priests or popes and protopopes or archpriests, who are the first clergy in the cathedrals and metropolitan churches. The lower clergy can rise no higher than protopopes, for the bishops are chosen from among the monks, and from the bishops are selected the archbishops, metropolitans, and patriarchs. In Russia, before the Revolution of 1917, there were twenty-four dioceses. The seats of the four metropolitans of the country were Petrograd, Kiev, Kasan, and Tobolsk. The dignities of Patriarch of Constantinople, Alexandria, Antioch, and Jerusalem still subsist. The Patriarch of Constantinople still possesses the ancient authority of his see; the other three patriarchs exercise a very limited jurisdiction, and live for the most part on the aid afforded them by the Patriarch of Constantinople. Repeated but fruitless efforts have been made to bring about a union between the Greek and Anglican Churches. The last proposition was made at Geneva in Aug., 1920.—BIBLIOGRAPHY: J. M. Neale, *History of the Holy Eastern Church*; Dean Stanley, *History of the Eastern Church*; W. F. Adeney, *Greek and Eastern Churches*.

Greek Fire, an inflammable and destructive compound used in mediæval warfare, especially by the Byzantine Greeks. It was poured from cauldrons and ladles, squirted through long copper tubes, or flung in pots, phials, and barrels. The art of compounding it was concealed at Constantinople with the greatest care, but it appears that naphtha, sulphur, and nitre entered into its composition. The German *flammenwerfer* (see *Flame-thrower*), employed by the enemy during the European War, may be considered as a counterpart of Greek Fire.

Greek Wines, though formerly well known in England under the names of Cyprus and Malmsey, are now less known than they deserve, several of them being strong, rich, full wines. Many different kinds of wines are produced both on the islands and the mainland, the former including those of Eubœa, Cephalonia, Corfu,

Zante, Santorin, &c.; the latter those of Achaia, Corinth, and Attica. Both white and red wines are exported, and some of the former resemble Hock and Chablis, some of the latter Burgundy.

Greeley, Horace, American journalist and politician, born in 1811, died in 1872. He worked first on a farm, then as compositor. In 1831 he went to New York, where, after an unsuccessful attempt to start *The Morning Post*, the first penny paper, he commenced in 1834 to issue *The Weekly New Yorker*, which ran for seven years. *The Log Cabin*, another weekly, established by him in 1840, reached a circulation of 80,000, and gave him a reputation which ensured the success of his *Daily Tribune*, founded in 1841, and edited by him till his death. In 1848 he was elected to Congress, but failed to impress his constituents with the necessity of returning him a second time. In 1851 he visited Europe, and was one of the jurors in the Great Exhibition. He opposed the Civil War, but was a firm supporter of the Union and of President Lincoln, and at the close of the war advocated a general amnesty and universal suffrage. In 1872 he was nominated for the presidency in opposition to General Grant, but was defeated. The strain of electioneering and the death of his wife brought on an illness, of which he died a few weeks later. Chief among his miscellaneous works are his *Hints towards Reforms* (1850), *Glances at Europe* (1851), *History of the Struggle for Slavery Extension* (1856), *The American Conflict* (1864), *Recollections of a Busy Life* (1869), and *What I Know of Farming* (1871).

Green, John Richard, historian, born in 1837, died in 1883. Ordained curate in 1860, he subsequently became vicar of St. Philips, Stepney, and librarian to the Archbishop of Canterbury at Lambeth. For some time he wrote constantly for *The Saturday Review*; but he was comparatively little known until the publication in 1874 of his *Short History of the English People*, which secured him immediate fame. It was followed by a larger edition of the same work entitled *A History of the English People* (1877–80), a volume of *Stray Studies from England and Italy*, and *The Making of England* (1882). His work was afterwards carried on in distressing conflict with lung disease, which brought about his death. *The Conquest of England*, his last work, was published posthumously by his wife, being almost complete at his death.—Cf. Sir Leslie Stephen, *The Letters of J. R. Green*.

Green, Thomas Hill, English philosophical writer, born 1838; Fellow of Balliol College in 1862, and first lay tutor on that foundation in 1867. In 1877 he was appointed Whyte's professor of moral philosophy; but his work was abruptly closed by his death in 1882. Apart

from his *Prolegomena to Ethics*, published posthumously in 1883, the bulk of his work was in the form of articles contributed to the *North British and Contemporary Reviews*. He was one of the strongest opponents of the English empirical school, leading the reaction against Hume's empiricism. The best edition of his works is that of R. L. Nettleship.—Cf. W. H. Fairbrother, *The Philosophy of T. H. Green*.

Green Algæ, or **Chlorophyceæ**, one of the principal subdivisions of the Algæ, including the great majority of the fresh-water forms together with a number of marine and a few terrestrial species. They are characterized by the pure green colour of their chromatophores and the relatively simple structure and small size (as compared with Brown and Red Algæ) of their thallus; the latter is most frequently filamentous, but unicellular types are common (e.g. *Chlamydomonas*, *Protocecus*), while on the other hand the green laver (*Ulva*) has a flattened leaf-like plant-body of considerable size. The reproductive methods are varied. Motile asexual spores (zoöspores) are frequent (except in *Conjugatæ*). Isogamous sexual reproduction is the rule, but oogamous types are found in most of the families. The oöspore of *Coleochaete* divides up into a clump of resting-cells covered by a protective sheath; this 'oöspore fruit' was formerly regarded as a simple type of sporophyte, but recent research has shown this view to be erroneous, as reduction of chromosomes takes place at the first division of the oöspore-nucleus. No true case of alternating generations is, in fact, known among Green Algæ. In spite of the evidently higher organization of the Brown and Red Algæ, it is customary to regard the Higher Plants (Cormiophyta)—which always have pure green chromatophores—as derived from Green Alga-like ancestors. The gap between the most complex Chlorophyceæ and the simplest Bryophytes is, however, serious, and the supposed immediate ancestors of the land-living plants must have been much more advanced than any known Green Alga. On the other side, the simplest Green Algæ (such as *Chlamydomonas* and its allies) grade almost insensibly into the green Flagellates. A natural classification of Green Algæ cannot be attempted until much more is known about the minute characters of their cells. The leading families, with representative genera, are as follows: (1) Volvocales. Permanently motile. *Chlamydomonas* (unicellular, isogamous), *Volvox* (multicellular, oogamous). (2) *Conjugatæ* (*Akontæ*). No motile cells. Isogamy by means of a conjugation tube. *Spirogyra* (filamentous), *Desmids* (unicellular). (3) *Protocecales*. Unicellular or forming loosely-connected cell-colonies. Never oogamous. *Scenedesmus*, *Hydrodictyon*. (4) *Ulotrichales*.

Filamentous (plate-like thallus in Ulva). Zoöspores general. Isogamous or oogamous. Ulothrix, Ulva, Oedogonium, Cephaleuros, Coleochaete. (5) Siphonales. Filamentous; filaments non-septate or with occasional^o septa, often interwoven. Usually isogamous. Vaucheria, Codium, Caulerpa, Cladophora, Struvea, Acetabularia. The Lower Fungi (Phycomycetes) show affinity with certain Siphonales and Protococcales. The economic value of Green Algæ is negligible. They occur in all parts of the world, many species having a very wide distribution.

Greenaway, Kate, English artist, born 1846, died 1901. Daughter of a wood-engraver, she was trained to art, and early became known by her charming designs for Christmas cards, children's books, &c., her quaint and pleasing figures of children dressed in old-fashioned costumes, and her flower designs, being specially noteworthy. As a book illustrator she soon made large sums of money, and became widely known. She was elected a member of the Institute of Painters in Water Colours, and exhibited in public galleries. Among her works are: *Under the Window*, *Mother Goose*, and *A Day in a Child's Life*.

Greenbacks, the popular name given to the paper currency first issued by the United States Government in 1862 during the Civil War. It is sometimes used also to include United States bank-notes.

Green Bay, a city of Wisconsin, United States, on Fox River, near the head of Green Bay. It has a great trade in lumber and various flourishing industries. Pop. 31,017.

Greene, Maurice, an English composer, born about 1696, died in 1755. He was in turn organist at St. Paul's, at the Chapel Royal, and held the chair of music at Cambridge. His works include a *Te Deum*, several oratorios, a masque, *The Judgment of Hercules*, an opera, *Phoebe* (1748), and various glees and catches. His collection of *Forty Select Anthems* is well known.

Greene, Nathanael, a general of the American revolutionary army, born at Potowhommet, Rhode Island, in 1742, died in 1786. In 1770 he was elected to represent Coventry in the General Assembly of Rhode Island, and was soon after excommunicated by the Quakers for taking arms on the prospect of war with Britain. In 1774 he joined the Kentish Guards as a private, and in May, 1775, he was appointed brigadier-general and commander of the Rhode Island contingent in the army before Boston. He gained at once the confidence of Washington, was made major-general, and appointed to the command in New Jersey. At Trenton (1776) and Princeton (1777) he led a division, and in the subsequent fighting he held important com-

mands, and repeatedly distinguished himself. In 1778 he was quartermaster-general, and in 1780 presided at the trial of Major André. In the same year he was appointed to the command of the southern army, and succeeded, after repeated defeats, in wresting Georgia and the Carolinas from the British.

Greene, Robert, English dramatist, born about 1560, died in 1592. He studied at St. John's College, Cambridge, and took his degree of B.A. in 1578, after which he travelled on the Continent. He graduated M.A. in 1583, lived a wild and profligate life, and died in poverty. His works consist of plays, poems, tales, and tracts. His chief romances are: *Pandosto* (1588), *The History of Arbasto* (1617), *A Pair of Turtle Doves* (1606), *Menaphon* (1587). His plays include: *The Honourable Historie of Friar Bacon and Friar Bungay* (1594); *Orlando Furioso* (1594); *Alphonsus, King of Arragon* (1597); and *James IV* (1598). Amongst his miscellaneous works are: *The Myrroure of Modestie* (1584); *Morando* (1584); *Euphues, his censure to Philautus* (1587); *Perimedes* (1588); *Alcida* (1588); *Spanish Masquerado* (1589); and various pamphlets and autobiographical works, such as his *Never-too-late* (1590), *Greene's Vision* (1592), *The Repentance of Robert Greene* (1592), and *Farewell to Folly* (1591). His *Groatworth of Wit bought with a Million of Repentance* (1592) is remarkable for the allusion to Shakespeare, "an upstart crow, beautified with our feathers". His *Pandosto, or the Triumph of Time* (also known as *Dorastus and Fawnia*) furnished the basis for Shakespeare's *Winter's Tale*. An edition of his plays and poems by Prof. Churton Collins appeared in 1905; a more recent edition of his works is that of T. H. Dickinson (1909).

Green Earth, an opaque, dull, olive-green, soft, earthy mass, generally met with in cavities in amygdaloidal rocks. It consists of silicate of iron and aluminium, with water. Some green earths are allied to glauconite and others to the chlorites.

Green-ebony, an olive-green wood obtained from the South American tree *Jacaranda ovalifolia*, nat. ord. Bignoniaceæ, used for round rulers, turnery and marquetry work, and also much used for dyeing, yielding olive-green, brown, and yellow colours.

Greenfinch, **Green-linnnet**, or **Green Grosbeak** (*Ligurinus chloris*), a bird of the finch family, and one of the most common of British and European birds. It frequents hedges, gardens, and small plantations, and feeds on grain, seeds, or insects. It easily becomes tame, but its song is not melodious. It builds in hedges, bushes, and low trees, the nest being of green moss and coarse fibrous roots, lined with finer roots, horsehair, and feathers. The eggs (four

to six) are bluish white, spotted at the larger end with purplish grey and dark brown. The general colours of the male are green and yellow, those of the female inclining to brown.

Greengage, a variety of the plum, the *reine claudé* of the French, introduced into Britain by a family named Gage. It is large, of a green or yellowish colour, and has a juicy, greenish pulp of exquisite flavour.

Greenheart (*Nectandra Rodiæi*), a tree of the nat. ord. Lauracæ, a native of Guiana, called also the *bebeeru*. Its wood is hard and durable, and is used in shipbuilding, not being liable to attacks from the Teredo. The bark contains the alkaloid bebeerine.

Greenland (Dan. and Ger. *Grönland*), an extensive island, the only colonial possession of Denmark, situated on the north-east of the continent of North America, from which it is separated by Davis Straits, Baffin Bay, and Smith Sound. It is more than 1700 miles in length, and at its broadest part 700 miles in width. It extends north to lat. 83° 39' and south to lat. 59° 45'. It has an area of about 46,740 sq. miles. Like the northern parts of North America generally, Greenland is colder than the corresponding latitudes on the east side of the Atlantic. In June and July the sun is constantly above the horizon, the ice on the coast is broken up and floats southward, and a few small lakes are opened; but the short summer is followed by a long and dreary winter. The interior, which is lofty and has the appearance of one vast glacier, is uninhabitable, and all the villages are confined to the coasts, which are lined with numerous islands, and deeply penetrated by fiords. The Danish colony extends north, on the western coast, to the Bay of Disco, in lat. 69° N. Cultivation is confined to the low shores and valleys, where grassy meadows sometimes occur with stunted shrubs and dwarfed birch, alder, and pine trees. Attempts to raise oats and barley have failed, but potatoes have been grown towards the southern extremity. Turnips attain the size of a pigeon's egg, and cabbages grow very small. The radish is the only vegetable which grows unchecked. The inhabitants are largely dependent upon hunting and fishing. Whale blubber and seal oil are used as fuel. Despite the proximity of America the flora and fauna are rather of a European character. The land animals are the Esquimaux dog, the reindeer, the polar bear, the Arctic fox (blue and white), the ermine, the Arctic hare, and the musk ox. Among the amphibia the walrus and several species of seal are common. The seas abound in fish, the whale and cod fisheries being of special importance. Sea-fowl are abundant in summer, and largely killed. The chief mineral

product is cryolite, but graphite and miocene lignitic coal are also found. Oil, eider down, furs, and cryolite are exported. The population, which is chiefly Esquimaux, numbers about 13,449 (1911). For administrative purposes Greenland, or rather its coast, is divided into two inspectorates of North and South Greenland. The capital is Godhaven, on Disco Island, but the largest settlement is Sydproven (pop. 780).

Greenland was discovered by an Icelandic named Gunnbjörn about 876 or 877. It was colonized from Iceland about the end of the tenth century, and other Scandinavians followed. In 1264 it was politically united with Norway, and about the middle of the fourteenth century possessed two flourishing colonies on the west coast, named West Bygd and East Bygd. These settlements, however, gradually disappeared from history, and the expeditions sent by Denmark in 1585, 1606, 1636, 1654, and 1670 for the purpose of finding the colony were unsuccessful. Various relics and inscriptions have been found. In the reign of Elizabeth Frobisher and Davis rediscovered the coast, but nothing was done to explore it until the Danish Government in 1721 assisted Hans Egede, a clergyman, to establish a European mission settlement, Good Hope (*Godhaab*), which was successfully carried on by him and his son. Whale-fisheries were established on the coast by the English and Dutch about 1590. The interior of the country (in the south) was first crossed from east to west by Nansen in 1888. The American explorer Commander Peary (1892) did much to make the northern parts known. Further explorations were undertaken by Nordenskiöld (1883), von Drygalski (1892), Garde (1893), Mylius Erichsen (1906-8), and Mikkelsen (1909-12). Between 1916 and 1918 Knud Rasmussen explored the north-eastern and northern parts of Greenland.—*Cf.* F. Nansen, *The First Crossing of Greenland*.

Green Mountains, a mountain range, United States, commencing near Newhaven, Connecticut, and extending north through Massachusetts and Vermont; highest summit, Mansfield Mountain (4279 feet).

Greenock, a municipal and parliamentary burgh and seaport town of Scotland, county Renfrew, on the southern shore of the estuary of the Clyde, there between 3 and 4 miles wide, about 20 miles west by north of Glasgow. It stands partly on a narrow level tract of land stretching along the margin of the sea; and partly on some heights, which rise behind, and to the south and west of the lower parts of the town. The lower and older parts of the town are mean and crowded. The principal public buildings are the custom-house, the tontine, the Watt monument, containing the Greenock

library, and the Watt Museum and Lecture Hall, the municipal buildings, the sheriff court buildings, and post office. South-west of the town is a beautiful cemetery. There are several pieces of ground devoted to recreation, and the river esplanade, 100 feet wide and 6200 feet long, forms a fine promenade. The manufactures include numerous sugar-refineries, shipbuilding yards, iron-foundries and machine establishments; chemical works; worsted, woollen, and paper mills; grain, saw, and sundry other mills; jute and bagging factories, roperies, and sail-making establishments. Greenock carries on a considerable coasting and foreign shipping trade, especially with East and West Indies, America, and Australia. The docks are spacious and possess every accommodation for shipping, including five graving docks and hydraulic and steam cranes. Large numbers of vessels unload at Greenock and ascend to Glasgow for cargoes. Unrefined sugar has long been the most valuable import, but has recently much declined; the exports to foreign parts are insignificant. Greenock was an important fishing and shipping port in the end of the seventeenth century, after which it began rapidly to extend. It was the birth-place of James Watt. Greenock sends one member to Parliament. Pop. (1921), 81,120.

Green Paints. See *Pigments*.

Green River, United States, Kentucky, flows generally west and north-west, and enters the Ohio 200 miles below Louisville. It is navigable for boats for about 200 miles.

Greensand, a sand rich in glauconite. The name is also used for two series of strata, occurring in the south-east of England, the Isle of Wight, &c., the one (lower greensand) belonging to the Lower Cretaceous series, the other (upper greensand) to the Upper Cretaceous series: between them is the clay called the Gault. They consist chiefly of sands, with clays, limestones, and chert bands. They were named on account of the green colour, due to glauconitic granules. The fossil contents are marine, and both deposits represent shore accumulations.

Greenshank, a well-known species of sandpiper (*Totanus glottis*), often called the whistling snipe from the shrill note it utters when first flushed. It breeds pretty commonly in the Hebrides, and sometimes in the north of Scotland, and is found as a visitor in the coast districts, lakes, and marshes of Britain. The bird is about 12 inches long, rather prettily marked, and has the legs and toes olive-green.

Greenstone, an old and conveniently comprehensive term for igneous rocks of various grain, but mostly crystalline throughout, with about 60 per cent or less of silica. Used in contradistinction to granite, and covering diorite, dolerite, &c.

Greenwich (grēn'ich), a municipal and parliamentary borough of London, on the right bank of the Thames, about 5 miles s.e. of London Bridge. It is built partly on an acclivity, but chiefly on the level ground skirting the river. There are extensive iron-foundries and engineering works, barge and boat-building yards, boiler works, mast-, block-, and sail-works, telegraph cable works, roperies, chemical factories, &c. The object of greatest interest is the magnificent hospital, the oldest portion of which was originally a palace of Charles II. It was converted to its charitable purpose in the reign of William and Mary. Three additional wings were built from designs by Sir Christopher Wren, who also completed the unfinished pile of Charles II. As a hospital for aged and disabled seamen of the navy, it was opened in 1705, and subsequently accommodated about 3000. In 1865, however, it ceased to be an asylum for seamen; since 1873 it has been the seat of the Royal Naval College, for the education of naval officers. It also contains a naval museum and picture gallery. Adjoining it are the Royal Naval School for boys, and an infirmary for sick and disabled seamen. Greenwich Park, an open, undulating piece of ground, area 180 acres, finely wooded and well stocked with deer, is a favourite resort of holiday-making Londoners during the summer. The celebrated observatory of Greenwich, erected by Charles II for Flamsteed, stands upon an eminence in the park. The longitude of all British maps and charts, and also of those issued by the Government of the United States of America, as well as many of those published in other countries, is computed from this observatory, which is 2° 20' 23" w. from the observatory of Paris, and 18° e. from the meridian of Ferro. Greenwich (including Deptford and Woolwich) was erected into a parliamentary borough in 1832, and returned two members to Parliament. Since 1918 Greenwich and Deptford send each one member, Woolwich returning two. Pop. 100,493.

Gregarin'idæ, or **Gregarines**, the old name for a large group of parasitic Protozoa. See *Sporozoa*.

Grégoire (grā-gwār), Henri, Comte, Bishop of Blois, a churchman and statesman of the French Revolution, born 1750, died at Paris in 1831. In 1789, while curé of Embarménil, in the district of Nancy, he was sent by the clergy of Lorraine as their representative to the States-General. As one of the secretaries of the Constituent Assembly he joined the extreme democratic section, and in the convention voted for the condemnation, though not for the death, of the king. Although extreme in his democratic opinions, he was an unflinching Jansenist. He was a member of the Council of Five Hundred,

of the Corps Législatif, and of the Senate (1801). On the conclusion of the Concordat he resigned his bishopric. He voted against the establishment of the Imperial Government, and alone in the Senate resisted the restoration of titles of nobility. He himself afterwards accepted the title of Comte, but in the Senate was always one of the small body who opposed Napoleon, and in 1814 was one of the first to vote for his deposition. He passed the latter part of his life in retirement. He left numerous works, among them *Ruines de Port-Royal* (1801), *Essai historique sur les libertés de l'Église Gallicane*, *Histoire des sectes religieuses depuis le commencement de ce siècle* (1810 and 1828), *Annales de la religion* (1795–1803).

Gregorian Calendar, the calendar as reformed by Pope Gregory XIII in 1582 (see *Calendar*). The *Gregorian year* is the ordinary year, as reckoned according to the Gregorian calendar.

Gregorian Tones, in music, a tonal system introduced by Gregory the Great. In the early ages of church music the Greek system of tetrachords, or what was supposed to be the Greek system, was followed. There were in the time of Ambrose of Milan fifteen so-called Greek modes or scales in use. In order to simplify church music he selected four of these scales, the Dorian, Phrygian, Æolian, and Mixo-Lydian, to which he attempted to reduce all the chants and melodies sung in church. This selection of scales was soon found to be too limited. The church singers refused to be bound to it, and it failed to represent the melodies actually in use. In these circumstances Gregory the Great introduced a new reform and extension of church music. To each of the scales admitted by Ambrose he added a new scale or mode, commencing with the fourth below the key-note of the original scale. These new scales he called *plagal*, while to the four introduced by Ambrose he gave the name of *authentic*. He introduced the practice of naming the tones by the letters of the alphabet. The following is the arrangement of his eight scales:

1st. Authentic (Dorian)	DEFGABCD
2nd. Plagal	AB CDEFGA
3rd. Authentic (Phrygian)	EFGAB CDE
4th. Plagal	BCDEFGAB
5th. Authentic (Æolian)	FGAB CDEF
6th. Plagal	CDEFGABC
7th. Authentic, Hyper-Dorian or Mixo-Lydian	GAB CDEFG
8th. Plagal	DEFGABCD

The scale of C, with the semitones between the 3rd and 4th, and the 7th and 8th, which in the modern system is called the natural scale, and is the pattern on which all the others are formed, was thus, it will be seen, one of the

plagal scales introduced as an innovation by Gregory.

Gregorovius, Ferdinand, German historian and poet, born at Neidenburg, 19th Jan., 1821, died at Munich, 1st May, 1891. Educated at Königsberg, where he studied theology and philosophy, he published several historical and literary works. In 1852 he went to Italy, where he remained until 1874. He also visited Greece, Egypt, Syria, and Constantinople. His works include: *History of the Roman Emperor Hadrian* (1851); *The Death of Tiberius*, a tragedy (1851); *The Island of Capri* (1868); and *The Tombs of the Roman Popes* (1857). His principal work, however, is his *History of Rome in the Middle Ages* (1859–73, 8 vols.). This monumental work is not only a history of Rome, but also of the Papacy and the Middle Ages.

Gregory, Patriarch of Constantinople, born in 1739; studied at Mount Athos, lived as a hermit, was made archbishop of Smyrna, and, in 1795, Patriarch of Constantinople. He led an active, tolerant, and benevolent life, and promoted schools and the art of printing. In 1798, however, and again in 1806, he was accused of intriguing for the freedom of Greece, and twice banished to Mount Athos, though each time restored to his post after a short interval. But in 1821, when the Greek insurrection broke out in the Morea, his native country, he became once more an object of suspicion to the Porte, and when, shortly after, he allowed the family of Prince Morousi to escape from his guardianship, he was seized as he left the church on the first day of the Easter festival and hanged in his robes of office before the church gate.

Gregory, the name of thirteen Popes, of whom we need notice only the following:—**Gregory I**, called also the *Great*, born at Rome, of noble family, about A.D. 540. He became a member of the Senate, and was made a prefect of Rome in 573. He expended his inheritance in the foundation of monasteries and charitable institutions, and then took monastic vows himself. Pope Pelagius II sent him on an embassy to Constantinople, and afterwards made him Papal secretary. On the death of Pelagius in 590 he was chosen his successor. He displayed great zeal for the conversion of heretics, sending missionaries to Sicily, Sardinia, Lombardy, England, &c., as well as for the advancement of monachism, and the enforcement of clerical celibacy. He died in 604. The works ascribed to him are very numerous; his genuine writings consist of a treatise upon *Pastoral Duty*, *Letters*, *Scripture Commentaries*, &c.—**Gregory VII** (*Hildebrand*), born about 1020 at Soana, in Tuscany; passed part of his early life in Rome, became a monk at Cluny, and then returned to Rome with Bruno on the election of the latter to the Papal chair.

He exercised great influence over Leo IX (Bruno) and his successors, Victor II, Nicholas II, and Alexander II; and under Nicholas II he succeeded in depriving the clergy and people of Rome of a voice in the election to the Pontificate by giving the power of nomination to the cardinals alone. On the death of Alexander II (1073) he was raised to the Papal chair. His chief aim was to found a theocracy in which the Pope should be the sovereign ruler, in political as well as ecclesiastical matters. He therefore prohibited simony and the marriage of priests (1074), and abolished lay investiture (1075), the only remaining source of the authority of princes over the clergy of their dominions. The Emperor Henry IV refused to obey this decree, and Gregory, after deposing several German bishops who had bought their offices from the emperor, and excommunicating five imperial councillors concerned in this transaction, summoned the emperor before a council at Rome to defend himself against the charges brought against him. Henry then caused a sentence of deposition to be passed against the Pope by a council assembled at Worms. The Pope, in return, excommunicated the emperor, and Henry, finding himself in difficulties, went to Italy and submitted at Canossa (1077) to a humiliating penance, and received absolution. After defeating Rodolph of Suabia, however, Henry caused the Pope to be deposed by the Council of Brixen, and anti-pope Clement III, to be elected in 1080, after which he hastened to Rome and placed the new Pope on the throne. Gregory passed three years as a prisoner in the castle of St. Angelo, and though finally liberated by Robert Guiscard, he was obliged to retire under the protection of Guiscard to Salerno, where he died in 1085.—**Gregory XIII** (*Ugo Buoncompagno*), born at Bologna in 1502; created cardinal in 1565; chosen successor of Pius V in the papedom in 1572. He permitted the Cardinal of Lorraine to make a public thanksgiving for the massacre of St. Bartholomew, encouraged plots against Queen Elizabeth, and incited Philip II to attack her. His foreign policy cost him much money for subsidies to excite enemies to the Turks and heretics, and his financial expedients to fill his exchequer ruined the trade and disturbed the peace of his own dominions. He did much to encourage education, his expenditure for this purpose exceeding two million Roman crowns, out of which many colleges at Rome were endowed. He reformed the Julian calendar (see *Calendar*). He died 10th April, 1585.—**BIBLIOGRAPHY:** H. K. Mann, *Lives of the Popes of the Middle Ages*; L. Pastor, *History of the Popes*.

Gregory, James, mathematician and inventor of the reflecting telescope, was born at Drumoak,

in Aberdeenshire, about 1638, and received his education at Marischal College. In 1663 he published *Optica Promota*, explaining the idea of the telescope which bears his name. He spent some years in Italy, and published at Padua in 1667 a treatise on the *Quadrature of the Circle and Hyperbola*. He became professor of mathematics at St. Andrews in 1668, and at Edinburgh in 1674, but died suddenly in 1675.

Gregory, James, physician, eldest son of John Gregory, M.D., born at Aberdeen in 1753, died in 1821. He studied medicine at Edinburgh, and in 1776 was appointed professor of the institutes of medicine. In 1780–82 he published his *Conspectus Medicinæ Theoreticæ*, in 1790 became professor of the practice of physic, and in 1792 issued his *Philosophical and Literary Essays*.

Gregory, John, physician, grandson of James Gregory, the inventor of the reflecting telescope, was born 1724, and died in 1773. He was successively professor of philosophy and medicine in King's College, Aberdeen, and of the practice of physic at Edinburgh. His works include: *Elements of the Practice of Physic*, *A Comparative View of the State and Faculties of Men and Animals*, and *A Father's Legacy to his Daughters*.

Gregory of Nazianzus (*Gregorius Nazianzēnus*), a Father of the Greek Church, born near Nazianzus, in Cappadocia, between A.D. 318 and 320, died in 380 or 390. He studied at Athens, and in 355 and 356 taught rhetoric in that city. He afterwards retired for some time with Basil to the Desert of Pontus. He began to preach in 362, and between 365 and 374 was associated with his father in the bishopric of Nazianzus. About 378 or 379 he went to Constantinople to oppose the Arians, and was appointed bishop of that see by Theodosius in 380, but in the following year retired to his former charge of Nazianzus. His works consist of letters, sermons, and poetry. His eloquence is nearly on a level with that of Basil and Chrysostom. His festival is on 9th May.—Cf. Smith and Wall, *Dictionary of Christian Biography*.

Gregory of Nyssa, a Father of the Greek Church, brother of St. Basil, born at Sebaste, Pontus, about A.D. 332, died about 398. By his brother's influence he was made Bishop of Nyssa, in Cappadocia. Having opposed the Arians, he was banished by Valens at their instigation from 375 to 378. He took a prominent part in the Councils of Constantinople from 381 to 394. His festival is on 9th March. His works consist of dogmatic treatises, Scripture commentaries, sermons, and letters.

Gregory of Tours (*Gregorius Florentius*), historian of Gaul, born in Auvergne in 539 or 544, died at Tours in 595. He became Bishop of Tours in 573. He had the courage to oppose

Chilperic and Fredegonde in their violent courses, and acted the part of a peacemaker in the dynastic quarrels of the period. His *Historia Francorum* is a valuable chronicle of sixth-century events.

Gregory's Mixture, a popular stomachic and aperient medicine, consists of two parts of rhubarb, six of magnesia, and one of ginger. It may be used with benefit occasionally, but not systematically.

Gregory Thaumaturgus, Saint, born in Pontus about A.D. 210, became a Christian at an early age, and was a disciple of Origen; was Bishop of Neocæsarea from 244 till his death in 270. His life and miracles are narrated by Gregory of Nyssa.

Gregory the Illuminator, Saint, the apostle of Armenia, born about A.D. 258. From 302 to 331 he was patriarch of the Armenian Church, but the last years of his life were passed as a hermit. He died about 342.

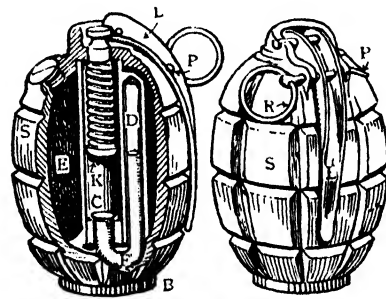
Greifswald (grifs'vált), a town of Prussia, province of Pomerania, on the navigable River Riek, about 3 miles above its entrance into the Baltic. It contains a university, founded in 1456, attended by about 1500 students, and possessed of a library (about 250,000 vols.), museum, observatory, &c. It has manufactures of machinery, oil, paper, and tobacco; and a considerable shipping trade. Greifswald was one of the Hanse towns about 1270; was assigned to Sweden by the Peace of Westphalia, 1648; was occupied successively by various northern powers, and finally ceded to Prussia in 1815. Pop. 24,679.

Greiz (grits), a town of Thuringia, in the former principality of Reuss Greiz, in a valley on the right bank of the Elster, 16 miles south of Gera. It is the residence of the elder branch of the Reuss family; is walled, well built, and has a castle and palace. Pop. 19,925.

Grenada, one of the British West Indian Islands; about 85 miles north-west of Trinidad; oblong in form, $24\frac{1}{2}$ miles long, N. to S., and 10 miles broad; area, 133 sq. miles. The island is traversed north to south by an irregular mass of volcanic mountains, attaining elevations of 3000 and 3200 feet above sea-level, and having lateral branches of lower hills. The valleys between these contain alluvial tracts of great fertility. On the south-east coast there is a considerable extent of unhealthy, low, swampy ground. In the centre of the island, about 1700 feet above sea-level, there is a circular lake, $2\frac{1}{2}$ miles in circumference, enclosed by lofty mountains. Rivers and rivulets are numerous; and most of the former are capable of working sugar-mills. The climate is oppressively hot on the low lands, but cool and pleasant on the hills. Sugar was formerly the chief article of cultivation; but at present cocoa stands by far the first among

the exports. The island has a Lieutenant-Governor, and a local legislature consisting of a nominated Council and a House of Assembly of seventeen elected members. The capital is St. George Town. Grenada was discovered by Columbus in his third voyage in 1498, and colonized about the middle of the seventeenth century by the French, who exterminated the Caribs. In 1762 it was taken by the British, and though recaptured by the French in 1779 was restored to Britain in 1783. English and a French patois are spoken. Pop. 60,750; estimated pop. in 1920, 74,400.

Grenade. This, in its original form, was a hollow sphere of metal of a convenient size for



Hand-bomb or Grenade

S, Grooved cast-iron shell. K, Spring-impelled firing-pin, adapted to operate on percussion cap C, in communication with time fuse F, leading to detonator D, which fires the explosive E. L, External lever held at "safety" by safety-pin P. R, Ring attached to safety-pin. B, Base, which unscrews for insertion of fuse and detonator.

throwing, filled with powder and provided with a length of fuse. When required for use as a missile weapon, the fuse was lighted and the grenade thrown in the required direction (see *Grenadier*). Grenades were probably first used in the sixteenth century; but in the course of time, as fire-arms improved and the distance at which engagements were fought increased, the grenade as a means of offence went out of use. In the European War, in consequence of the hand-to-hand nature of the fighting which developed under the conditions prevailing in trench warfare, the grenade was resuscitated. The modern grenade is of two main forms—one for use from a rifle, and one designed for throwing by hand. The hand-bomb or grenade is possibly the more usually known, and the one now in use in the British army is known as the Mills grenade or hand-bomb. In shape it is like a small barrel, some $4\frac{1}{2}$ inches high, constructed of cast iron with a coarsely-granulated and deeply-furrowed surface designed to assist in the formation of splinters on explosion. It is loaded with an explosive known as ammonal, which possesses the

advantage of being very hard to explode by a mere concussion, and requires to be detonated by a proper detonating agent. At one end of the grenade case is a screw cap, at the other a firing-pin. The cap, on being removed, exposes a cavity into which the detonator is fixed; the firing-pin is prevented from falling by a collar engaging on a strip of metal attached to the outside of the case, and working with a spring fixed inside. In the safety position the spring is prevented from acting on the metal strip retaining the striker by a split-pin arrangement, and in the firing position, after the pin has been removed, by the pressure of the hand grasping the bomb and holding down the metal strip. The split pin is not withdrawn till the very moment of throwing, and, as the grasp of the hand is relaxed as the grenade leaves the hand, the spring is allowed to work, the firing-pin falls, and the charge is detonated five seconds later. An expert can throw a Mills bomb about 45 yards, a fair average throw being 35 yards. The area of effect is some 25 yards.

Grenadier, originally a soldier trained in the use of the hand grenade (q.v.). At the present time the word survives in the titles of the first regiment of foot guards (q.v.), and in two regiments of the Indian army, the 101st and 102nd Grenadiers. Formerly every regiment of infantry had its grenadier company, which took its place on the right of the line, and into which all the men of the finest physique were drafted. The method of fighting by means of the hand-grenade peculiar to the earlier grenadiers necessitated the slinging of the musket over the shoulder. The customary head-dress in those days was a three-cornered hat; the shape of this was found to interfere with the proper performance of the necessary motions for slinging the musket, and this led to the introduction of the grenadier cap, in its original form a tall mitre-shaped head-dress with no protruding corners.

Gren'adines, a chain of small islands and rocks, West Indies, between the Islands of Grenada and St. Vincent; principal island, Carriacou. They produce coffee, indigo, cotton, and sugar. Pop. about 6886.

Grenfell, George, British missionary and explorer, born near Penzance, Cornwall, 1840, died 1906. Educated at the Baptist College, Bristol, he was sent in 1874 by the Baptist Missionary Society to the Cameroons, reached the Congo, and rendered valuable services to science by his hydrographic survey of the Congo. In 1885 he explored the Mubangi, identifying it with the Welle Mukua. After Livingstone, Grenfell was one of the most intrepid travellers, who contributed considerably to the accurate scientific knowledge of the interior of Africa. In 1891 he was a member of the Commission

appointed to delimit the boundary line between the Belgian and Portuguese possessions along the Lunda frontier.

Greno'ble, a fortified town of Southern France, capital of the department of Isère, finely and strongly placed on the Isère, 60 miles s.e. of Lyons, on both sides of the river, which is crossed by three bridges and lined by fine quays. It has a cathedral, and a noteworthy church (Saint-André), formerly the chapel of the dauphins of the Viennois, with the monument of Bayard; a public library of over 400,000 volumes and 7500 MSS.; a university founded in 1339, museum, bishop's palace, court-house, arsenal, and extensive public gardens. The manufactures consist of gloves, linen goods, liqueurs, and leather. Grenoble existed in the time of Cæsar; and Gratian, who had improved it, changed its name from Cularo to Gratianopolis (whence *Grenoble*). Pop. 77,438.

Grenville, George, a British minister, younger brother of Earl Temple, and father of William Wyndham, the first Lord Grenville; born in 1712, died in 1770. He became Treasurer of the Navy in 1754; Secretary of State and subsequently First Lord of the Admiralty in 1762; First Lord of the Treasury and Chancellor of the Exchequer in 1763. In 1763 he introduced a scheme of colonial taxation, and in 1764 proposed a stamp tax to be levied in the American colonies, which was one of the causes of the American War of Independence. In 1765 he was succeeded in office by Lord Rockingham. *The Grenville Papers* (1852-53) contain his most important political correspondence.

Grenville, Sir Richard, British naval commander, a cousin of Sir Walter Raleigh, born about 1541, died in 1591. After performing such public duties as fell to a man of his position, and having distinguished himself in naval exploits against the Spaniards, in 1591 he was in command of the *Revenge* of 500 tons and 250 men, as vice-admiral under Lord Thomas Howard, who was sent to the Azores for the purpose of intercepting homeward-bound Spanish treasure-ships. Suddenly the Spaniards appeared with an overwhelming force of men-of-war, and Howard, seeing that resistance was useless, gave the enemy the slip. Sir Richard, however, was cut off from his countrymen, either by his own intention or accidentally, and instead of surrendering determined to fight to the last. For fifteen hours he kept up a desperate resistance, and when at last the *Revenge* was reduced to a helpless wreck the sorely wounded hero and the remnants of his gallant crew were overpowered and taken prisoners. Sir Richard died within two or three days on board one of the Spanish vessels, and soon after the *Revenge* went down in a great storm. Tenny-

son's ballad of *The Revenge* commemorates the incident.—Cf. Hakluyt, *Voyages*, vols. ii and iii.

Grenville, William Wyndham, Lord, third son of George Grenville, was born 1759, died in 1834. In 1783 he was appointed Paymaster-General of the Army; in 1789 became Speaker, and in the same year became Secretary of State for the Home Department. In 1790 he was created Baron Grenville, and from 1791 till Pitt's resignation in 1801 held the post of Foreign Secretary. On the return of Pitt to office in 1804 he declined to join him, and continued in opposition till Pitt's death, when he became the head of a coalition ministry, including Fox and Grey, 1806. This ministry resigned in 1807, after having passed an Act for the abolition of the slave-trade. He did not again take office.

Gresham, Sir Thomas, a merchant of London, born in 1519, died in 1579. In 1552 he was sent as agent of Henry VIII's money affairs to Antwerp, where in two years he paid off a heavy loan, and raised the king's credit considerably. On the accession of Elizabeth he was deprived of his office, but it was soon restored to him, with that of queen's merchant, and he was also knighted. In 1556 he planned and erected at his own expense an exchange (afterwards called by Elizabeth the Royal Exchange) for the merchants of London, in imitation of that of Antwerp. He founded in 1575 Gresham College, London (in which courses of lectures are given), and at his death set aside large sums for charitable institutions.

Gresham's law is the principle of economics that bad money drives out good. It was so named by Macleod in 1857, under the mistaken notion that the principle was first formulated by Sir Thomas Gresham in 1558. Earlier economic writers had stated the law clearly; and it was known at least as early as the time of Aristophanes.—Cf. *Frogs*, 720, sqq.

Gresset (grä-sä), Jean Baptiste Louis, a French poet, born at Amiens, 1709, died in 1777. At the age of twenty-four he produced a small poem full of graceful badinage called *Vert Vert*, the subject being the adventures of a parroquet. It was followed by other pieces in a similar style.

Gretna Green, a village of Scotland, in Dumfriesshire, on the Solway Firth, 8 miles north of Carlisle, for nearly a century notorious for the celebration of the marriages of fugitive lovers from England. To conclude a lawful (though irregular) marriage in Scotland it is only necessary for an unmarried couple to go and declare themselves man and wife before witnesses, and it was in this way that these runaway couples were married; but such marriages were put an end to, in 1856, by an Act declaring that no irregular marriage in Scotland

shall be valid unless one of the parties has resided in Scotland for twenty-one days next preceding such marriage. During the European War the largest British munition factory was established near Gretna. This was eventually closed after the Armistice, and in 1921 was abandoned by the Government and offered for sale.

Greuze (greuz), Jean Baptiste, a famous French painter, born in Burgundy 1726, died in 1805. Although he devoted some time and attention to historical subjects, he afterwards confined himself to depicting scenes of the family life of the *bourgeois* or middle class. As a colourist he occupies a high place. Among his works the following may be mentioned: *The Village Marriage*, *The Wicked Son Punished*, *The Broken Pitcher* (all in the Louvre); *The Broken Mirror*, *Innocence* (in the Wallace Collection, London); *The Dead Canary* (National Gallery, Edinburgh).

Greville, Fulke, Lord Brooke, English writer, born in 1544. Having studied at Cambridge and Oxford and made the tour of Europe, he became a courtier, and enjoyed the favour of Elizabeth, James I, and Charles I. In 1628 he was stabbed by an old servant, and immediately expired. He wrote the *Life of Sir Philip Sidney*; and a collection of verse entitled *Calica*, containing CIX Sonnets.

Grevillea, a large genus of Australian shrubs and trees, ord. Proteaceæ. Some yield timber; young plants of *G. robusta* are often grown in pots for their ornamental fern-like foliage.

Grey, Charles, Earl, English statesman, eldest son of Charles, first Earl Grey, born in 1764, died in 1845. He was educated at Eton and at King's College, Cambridge. In 1786 he was returned to Parliament as member for Northumberland. On the accession of the Grenville ministry in 1806, Grey, now Lord Howick, was made First Lord of the Admiralty, and on the death of Fox succeeded him as Secretary for Foreign Affairs and leader of the House of Commons. The death of his father in 1807 raised him to the House of Peers, and from this period up to 1830 he headed the opposition in the Lords, and especially opposed the proceedings against Queen Caroline. On the accession of William IV and the retirement of the Wellington ministry, Earl Grey was summoned to office. The great event which marks his administration is the passing in 1832 of the First Reform Bill. In 1834 Earl Grey resigned, and was succeeded by Lord Melbourne. The remainder of his life was chiefly spent in retirement.—Cf. Charles Grey, *Life and Opinions of Charles, Second Earl Grey*.

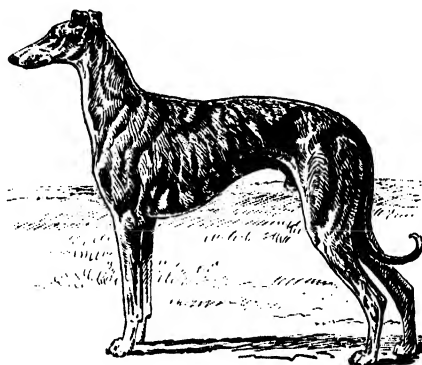
Grey, Sir George, statesman and colonial governor, born at Lisbon 1812, died in London in 1898. He was for ten years in the army, carried

on explorations in Australia during 1837-9, and in 1841 was appointed Governor of South Australia, becoming Governor of New Zealand in 1846, where he had Maori and other troubles to deal with. From 1854 to 1861 he was Governor of Cape Colony, a post in which he was highly successful, his prompt dispatch of all available troops to aid in quelling the Indian Mutiny being a noteworthy incident. From 1861 to 1867 he was again Governor of New Zealand; had difficulties with the Maoris, gave offence to the Home Government, and was recalled. Subsequently (1877-80) he was Premier of New Zealand, and afterwards resided in England. Besides writing an account of his Australian explorations, he published poems, traditions, and chaunts of the Maoris; *Polynesian Mythology*; and *Ancient Traditional History of the New Zealand Race*.

Grey, Lady Jane, Queen of England for nine days, born in 1537, died in 1554. She was the daughter of Henry Grey, Marquess of Dorset, afterwards Duke of Suffolk, by Frances, daughter of Charles Brandon, Duke of Suffolk, and Mary, younger sister of Henry VIII. She displayed much precocity of talent; and under the tuition of Aylmer, afterwards Bishop of London, she acquired a knowledge of the learned languages, as well as French and Italian. She was married to Lord Guildford Dudley, fourth son of the Duke of Northumberland, in 1553. Edward VI, who died in 1553, was induced on his death-bed to settle on her the succession to the crown. The Council endeavoured to keep his death secret, with a view to securing the persons of the princesses, Mary and Elizabeth, and when Mary discovered the design the Council proclaimed Lady Jane queen. On the approach of Mary, however, the Council deserted Lady Jane, and Mary was proclaimed queen. Jane was now confined to the Tower. She and her husband were arraigned, and pleaded guilty of high treason; but their doom was suspended, and it was not until after the suppression of the rebellion of Sir Thomas Wyatt, in which the Duke of Suffolk, Lady Jane's father, had participated, that the sentence was executed. She was beheaded on Tower Hill, 12th Feb., 1554, her husband having previously suffered the same day.—Cf. R. Davey, *The Nine Days' Queen: Lady Jane Grey and her Times*.

Greyhound, a variety of dog, distinguished by a greater length of muzzle than any other; very low forehead, short lips, thin and long legs, small muscles, contracted belly, and semipendent ears. There are several varieties, as the Irish greyhound, the Scottish, the Russian, the Italian, and the Turkish. The common greyhound is of a slender make of body, and is universally known as the swiftest of dogs. A good hound has a fine,

soft, flexible skin, with thin, silky hair, a great length of nose, contracting gradually from the eye to the nostril, a full, clear, and penetrating eye, small ears, erect head, long neck, chest capacious, deep, but not wide, shoulders deep and placed obliquely, ribs well arched, contracted belly and flank, a great depth from the hips to the hocks of the hind-legs, fore-legs straight, and shorter than the hinder. The name appears to have no reference to the colour, but is derived from the Icelandic *grey*, a dog. They are chiefly used in the sport of coursing, a work for which their peculiar shape, strength, keenness of sight, and speed make them exceedingly well fitted. This sport is preferred by many to horse-racing, and large kennels of greyhounds are kept by



Greyhound

several of the nobility and gentry, who also further the sport by preserving hares, and providing suitable coursing-grounds. (See *Coursing*.) The chief breeds are the Newmarket, the Lancashire, and the Scottish.

Greymouth, a seaport of New Zealand, on the west coast of South Island, province of Westland, in a district where coal is mined and gold obtained. Pop. 5469.

Grey of Fallodon, Edward, first Viscount, British statesman, born 25th April, 1862. A grandson of Sir George Grey, for many years Secretary of State for Home Affairs, he was educated at Winchester and at Balliol College, Oxford. In 1885 he entered Parliament as a Liberal member for Berwick-on-Tweed, and continued to sit for this constituency till 1916. Early in his career Gladstone is said to have predicted for the young member a great future. And, indeed, this prophecy became true, for Grey was destined to dominate the Councils of Europe more than any of his predecessors at the Foreign Office since 1854. His first opportunity to show his capacity for parliamentary life, his comprehensive grasp of political problems, and

his diplomatic skill came when he was appointed Under-Secretary for Foreign Affairs in 1892 in the Rosebery Cabinet. He enhanced his reputation during the time when the Liberal party was in opposition, and in 1905 he became Secretary of State for Foreign Affairs in the Campbell-Bannerman ministry, retaining his office till 1916. During his tenure of office the Triple Entente, uniting Great Britain, France, and Russia, was developed, an Anglo-Russian agreement was concluded in 1907, settling rivalries in Asia, and the Peace of London, putting an end to the Balkan War, was signed on 30th May, 1913. He failed, however, to bring about more cordial relations with Germany, and in 1911, during the quarrel between France and Germany over Morocco, he was on the side of France. In spite of his earnest endeavours and continued efforts to preserve peace during the last twelve days preceding the outbreak of the European War, in spite of his appeals to Germany and Austria, he did not succeed, and when he saw that war was unavoidable, he did not hesitate to commit his country to the general struggle. In a famous historic speech, delivered on 1st Aug., 1914, he defined Britain's attitude, and the House of Commons decided to stand by the side of France against Germany. A K.C. since 1912, he was created a viscount in July, 1916, and in December of the same year resigned with Asquith. He became one of the most ardent supporters of the idea of a League of Nations, and wrote a famous pamphlet on the subject in 1918. In spite of his impaired eyesight, he occasionally appeared on the public platform, and in Oct., 1919, he went on a special mission to the United States, returning in Jan., 1920. He was elected President of Armstrong College, Newcastle-on-Tyne, in 1918.—Cf. Gilbert Murray, *The Foreign Policy of Sir E. Grey* (1915).

Greytown, San Juan de Nicaragua, or San Juan del Norte, the principal seaport of the Central American republic of Nicaragua, situated at the mouth of the San Juan. Pop. 2500.

Grieg, **Eduard**, Norwegian musical composer, born in 1843, died in 1907. He studied at Leipzig and at Copenhagen, and, after spending a few years in Christiania, received a government pension which enabled him to settle in Bergen and devote his whole time to composition. His most notable works are the music to Ibsen's play *Peer Gynt*, and his refined and lyrical renderings of Norwegian folk songs and dances.

Griffin, or **Gryphon**, a fabulous monster of antiquity, commonly represented with the body, the feet, and claws of a lion, and the head and wings of an eagle. India, or Scythia, was anciently assigned as the native country of the griffins; and it was alleged that they guarded

the gold in the mountains. The griffin is frequently used as a charge in heraldry. Hundreds of families in Great Britain, and particularly in Wales, adopted the griffin as the emblem on their family arms.

Grillparzer (gril'pär-tsér), Franz, a German poet and dramatist, born at Vienna 15th Jan., 1791, died there in 1872. Having entered the service of the imperial court, he rose through various dignities, and at last was appointed member for life of the Imperial Council. He was the author of lyrical and other poems, a novel, and travels, and of the dramas *Sappho*, *Das Goldene Vlies*, and *Des Meeres und der Liebe Wellen*. Perhaps the finest of his productions is the historical drama of *König Ottokars Glück und Ende*.

Grilse, or **Peal**, a name given to the young of the salmon (smolts) after they return for the first time from the sea to fresh water. They then sometimes weigh from 5 to 8 or 9 lb.

Grimaldi Family, one of the four families of the high nobility in Genoa. The lordship of Monaco belonged, for more than 600 years (beginning with 980), to the Grimaldi, and the present ruler of the House of Goyon-Matignon still bears the name of Grimaldi. With the Fieschi they always played an important part in the history of Genoa, especially in the disputes between the Ghibellines and the Guelfs, to which latter party both families belonged.

Grimaldi's Fringes, coloured diffraction bands first observed and described by Grimaldi in 1665.

Grimm, Friedrich Melchior, Baron, German man of letters, born at Ratisbon in 1723, died at Gotha in 1807. He lived mostly in Paris and wrote in French. Having finished his studies, he went to Paris and there became acquainted with Jean Jacques Rousseau, Diderot, D'Alembert, D'Holbach, and other Parisian philosophers. He corresponded with Catherine II of Russia, Gustavus III of Sweden, and other great personages. Frederick the Great among others gave him marks of great esteem. In 1776 he was appointed envoy from the Duke of Saxe-Gotha to the French court, and honoured with the title of baron. On the Revolution breaking out he retired to Gotha, where he died. His *Correspondance Littéraire* possesses great literary and historical value.

Grimm, Jakob Ludwig, a German philologist, born at Hanau, in Hesse-Cassel, 1785, died at Berlin 1863. He was educated partly at Cassel, and finally at Marburg University. In 1806 he became librarian to Jerome Bonaparte, King of Westphalia, and from 1816 to 1829 he occupied the post of second librarian at Cassel. From 1830 to 1837 he resided at Göttingen as professor and librarian, lecturing on the German language,

literature, and legal antiquities. Having, along with six other professors, resisted the unconstitutional encroachments of the King of Hanover, he was banished, and after his retirement to Cassel he was, in 1841, called to Berlin as a professor and member of the Academy of Sciences. He sat in the National Assembly of 1848, and in that of Gotha in 1849. From that time till his death he occupied himself only with his various publications. He wrote on German mythology, German legal antiquities, the history of the German language, and published old German poems. His two greatest works, both unfinished, are his *Deutsche Grammatik* (German Grammar, vols. i-iv, 1819-37), and his *Deutsches Wörterbuch* (German Dictionary), commenced in 1852, in conjunction with his brother Wilhelm, and being gradually completed by eminent scholars. He also published, in company with his brother, the *Kinder- und Hausmärchen*, one of the most popular collections of juvenile fairy tales.

Grimm, Wilhelm Karl, brother of the preceding, born 1786, died in 1859. Educated at Cassel and Marburg, he followed his brother to Göttingen, and obtained a professorship. He joined in his brother's protest against the abrogation of the new Hanoverian Constitution, and was deprived of his office, but obtained an appointment in Berlin. He devoted himself especially to the German mediæval poetry, and published a treatise, *Ueber die deutschen Runen*, a translation of *Altdänische Heldenlieder*, and *Balladen und Märchen*, all with valuable introductions and disquisitions.

Grimma, a town of Saxony, on the Mulde, 17 miles E.S.E. of Leipzig, charmingly situated, and with some interesting old buildings. Pop. 11,440.

Grimm's Law, so called from its discoverer, Jakob Grimm, formulates the principle of the

interchange of the mute consonants in the Aryan languages, in words derived from the same roots. For example: *p*, *b*, and *f* in Latin, Greek, and Sanskrit are in Gothic and English, Dutch, &c., respectively represented by *f*, *p*, and *b*, and in Old High German by *b* (*v*), *f*, and *p*. The subjoined table exhibits the principal mutations:—

	Labials.	Dentals.	Gutturals.
Greek (Latin, Sanskrit) . .	<i>p, b, f</i>	<i>t, d, th</i>	<i>k, g, ch</i>
English (A.Sax.), Gothic, &c. . .	<i>f, p, b</i>	<i>th, t, d</i>	<i>h, k, g</i>
Old High German . .	<i>b (v), f, p</i>	<i>d, g, t</i>	<i>g, ch, h</i>

As examples: E. *father* = Lat. *pater*, Gr. *patēr*, Skr. *pitri*; E. *brother* = Lat. *frater*, Gr. *phratēr*, Skr. *bhratar*; E. *kin* = *genus*, Gr. *genos*; E. *head*, A.Sax. *heafod* = Lat. *caput*, Gr. *keph(alē)*, &c.; E. *thin* = Lat. *tenuis*, Gr. *tanaos*. Certain exceptions to the law are explained by a law subsequently discovered, called Verner's law. See *Philology*.

Grimsby, formerly Great Grimsby, a parliamentary, municipal, and county borough and thriving seaport, England, county of Lincoln, on the Humber. The docks occupy an area of about 140 acres, and there is a large trade with Continental ports. Grimsby is one of the most important British fishing-ports. It sends one member to Parliament. Pop. 82,329.

Grimsel (grim'z'l), a pass in Switzerland, at the eastern extremity of the Bernese Alps, 7103 feet in height, and connecting the valleys of the Aar and the Rhône.

Grindelwald (grin'dl-vált), one of the most beautiful of the upper Alpine valleys of Switzerland, about 36 miles south-east of Berne, containing two immense glaciers. The village of Grindelwald consists of picturesque cottages, and the inhabitants, about 3500 in number, are chiefly employed in rearing cattle.

